

DIGITAL VERSION

Intel Skylake full review

Are Intel's new processors worth the two-year wait?



COMPUTER SHOPPER

The **FIX IT** issue

Windows 10

FIXED

**Performance, licensing
and privacy problems SOLVED**

PLUS!

Windows 10 PCs

Latest Intel processors, hybrid hard disks
and top-spec graphics cards for £600



Cameron's web porn block

Can it really protect your children?

The sharing economy

Saving you money or stealing your job?

Goodbye digital

Are analogue computers the future?



WIRED2FIRE

www.wired2fire.co.uk

Free Delivery
Code CS333

100% Dedicated to Gaming PCs!

DIABLO ULTIMA



Corsair Carbide SPEC01 Case
FSP 500W Bronze Power Supply
Intel Core i3 4160 (3.5GHz)
AMD R9 380 2GB GDDR5 Graphics
Asus Z97-P Motherboard
8GB Samsung 1600MHz DDR3 Memory
120GB Kingston SSD
Windows 8.1 Gaming Optimised
3 Year Warranty

£589 Inc VAT

DIABLO REACTOR



NZXT H440 Case
FSP 600W Silver Power Supply
Intel Core i5 4690K (4.3GHz+)
nVidia GTX 970 4GB GDDR5 Graphics
Asus Z97-P Motherboard
8GB Samsung 1600MHz DDR3 Memory
240GB Kingston SSD
Windows 8.1 Gaming Optimised
3 Year Warranty

£899 Inc VAT

DIABLO PREDATOR



Cooler Master CM690 III Case
FSP 750W Silver Power Supply
Intel Core i5 6600K Skylake (4.4GHz+)
nVidia GTX 980 4GB GDDR5 Graphics
Asus Z170 Pro Gaming Motherboard
16GB Corsair 2400MHz DDR4 Memory
250GB Samsung 840 EVO SSD
Windows 8.1 Gaming Optimised
3 Year Warranty

£1299 Inc VAT

DIABLO ELITE



Corsair Graphite 780T Case
FSP 1000W Aurum Pro Platinum PSU
Intel Core i7 6700K Skylake (4.4GHz+)
DUAL SLI GTX 970 4GB GDDR5 Graphics
Asus Z170 Pro Gaming Motherboard
16GB Corsair 2400MHz DDR4 Memory
250GB Samsung 840 EVO SSD
Windows 8.1 Gaming Optimised
3 Year Warranty

£1649 Inc VAT

INFERNO PREDATOR



PORTABLE
DESKTOP
POWER

15.6" Backlit Predator Chassis
Intel Core i5 4690 (desktop CPU)
nVidia GTX 970M 6GB GDDR5 Graphics
8GB Kingston 1600MHz DDR3 Memory
250GB Samsung 850 EVO SSD
Windows 8.1 Gaming Optimised
3 Year Warranty

£1199 Inc VAT

THE BEST GAMING PCS ON THE PLANET



Call 01306 882211 or email sales@wired2fire.co.uk

Welcome!



FRANKLY, WE'RE AMAZED the Windows 10 rollout went as well as it did. We only started to see properly finished-looking builds in the week before launch, and with 75 million installations in a short period on who knows how many hardware combinations, there was plenty of scope for things to go wrong.

However, although there don't seem to have been many catastrophic meltdowns, Windows 10 is not without its 'charming quirks'. We've been keeping an eye on the problems people have been having with the new operating system, from licensing and privacy settings issues to slow bootup times, and in this month's feature we show you how to fix them. Turn Windows 10 from good to great, starting on page 96.

Meanwhile, if you want to see what all the fuss is about but can't upgrade your current computer, or just want something shiny, new and powerful to show Windows 10 at its best, we've reviewed a fantastic selection of Windows 10 PCs, for just £600 or £700 with a monitor.

Since Intel launched its Haswell processors in 2013, things have been rather quiet on the CPU front; last year's Broadwell chips were a bit of a non-event. For this reason we've been waiting eagerly for Haswell's replacement, and it's finally here. Skylake is a big jump, being quicker than Haswell in both applications and games, and with some serious scope for overclocking. Read how Intel finally got it right on page 24.

You've probably seen taxi company Uber hogging the headlines and seen adverts for accommodation company Airbnb all over the place. You may even have found someone on TaskRabbit to screw together your IKEA wardrobe. These companies are part of the so-called sharing economy, which promises to put consumers directly in touch with individuals providing services, at rock-bottom prices. But how does this new way of doing business work, and is it a recipe for exploitation at the hands of ruthless Silicon Valley entrepreneurs? Our feature on page 104 aims to find out.

Chris Fennamore, Editor
chris@computershopper.co.uk

CONTACT US

Editor Chris Fennamore chris@computershopper.co.uk
Features Editor Seth Barton seth@computershopper.co.uk
Product Editor Tom Morgan tom@computershopper.co.uk
Senior Reporter Katharine Byrne katharine@computershopper.co.uk
Senior Staff Writer Michael Passingham michael@computershopper.co.uk
Senior Staff Writer Richard Easton richard@computershopper.co.uk

DESIGN

Art Editor Colin Mackleworth

CONTRIBUTORS

Bill Bagnall, Gareth Beach, Mike Bedford, Barry Collins, Mel Croucher, Kay Ewbank, Steve Haines, Simon Handby, Gordon Holmes, Ben Pitt, Heather Reeves, David Robinson, Clive Webster

ADVERTISING

Email ads.shopper@dennis.co.uk
Group Advertising Manager Andrea Mason 020 7907 6662
Advertising Manager Charlotte Milligan 020 7907 6642

COVER GIFT CONTACT

Chris Wiles coverdiscs@computershopper.co.uk

SUBSCRIPTIONS

Tel 0844 844 0031 / 01795 592905 Web www.subsinfo.co.uk
 UK £44.99, Europe £70, Rest of world £90

PHOTOGRAPHY

Henry Carter, James Walker, Natalie Tkachuk, Svetlana Bardarska

LICENSING AND SYNDICATION

Ryan Chambers 020 7907 6132 Ryan_Chambers@dennis.co.uk
 Licensing, Reprints, Eprints: Wright's Media 0800 051 8327

MANAGEMENT

Tel 020 7907 6000

Group Editor David Ludlow david@computershopper.co.uk
Group Managing Director Ian Westwood
Managing Director John Garewal
Group Advertising Director Julian Lloyd-Evans
Circulation Director Martin Belson
Finance Director Brett Reynolds
Group Finance Director Ian Leggett
Chief Executive James Tye
Company Founder Felix Dennis

PRINTING

Printed by Polestar, Bicester, Oxon
 Distributors Seymour 020 7429 4000

LIABILITY

While every care was taken preparing this magazine, the publishers cannot be held responsible for the accuracy of the information or any consequence arising from it. All judgements are based on equipment available to *Computer Shopper* at the time of review. 'Value for money' comments are based on UK prices at time of review.

Computer Shopper takes no responsibility for the content of external websites whose addresses are published in the magazine.

COMPUTER SHOPPER INCORPORATES UPGRADE SHOPPER, GAMES SHOPPER, INTERNET SHOPPER, MOBILE SHOPPER, PC SHOPPER, PORTABLE SHOPPER AND SOFTWARE SHOPPER

A DENNIS PUBLICATION

Computer Shopper is published by Dennis Publishing Ltd, 30 Cleveland Street, London W1T 4JD. Company registered in England. All material © Dennis Publishing Limited licensed by Felden 2015, and may not be reproduced in whole or part without the consent of the publishers. ISSN 0955-8578

© Copyright Dennis Publishing Limited

QUESTION OF THE MONTH

What special skills do you have to rent out to the sharing economy?

MEET THE TEAM



Chris Fennamore

“I'm like a Shazam for anything on Radio 1 between 1991 and 2003”



David Ludlow

“I am blessed with unlimited cat-sheltering resources”



Katharine Byrne

“All aspects of popular Japanese culture explained in easy-to-understand terms”



Michael Passingham

“I have 'perfect pitch', meaning I'm actually an extremely effective instrument tuner”



Seth Barton

“Will furnish opinions on any subject for minimal outlay”



Tom Morgan

“Will provide appropriate Simpsons reference for any given situation”



Richard Easton

“I am the IMDB of obscure movie quotes (preferably involving Michael Caine)”

SUBSCRIBE AND SAVE



**CALL 0844 844 0031
OR SEE PAGE 126**

Contents



Regulars

6 Letters

Your regular missives of wit and wisdom

10 Under Development

Internet security is a minefield, and reading too much about the subject can make you paranoid. This is why **David Robinson** prefers to stick to tried-and-tested approaches when protecting his PC

12 Cybercop

Our resident policeman not only has a gift for cybersecurity; he can also see into the future, as recent vindicating events show

14 Rants & Raves

It's not my fault, damn it! All **Mel** wants is for the world to stop blaming him for its ills. Meanwhile **Katharine** and **Tom** have found tech beauty comes in small packages

146 Zygote

You can tell competitive video games are getting serious when the players start taking performance-enhancing drugs, says **Zygote**. Maybe those drugs would be better served enhancing the performance of the UK government's IT departments?

News

16 Newsfile

Our monthly round-up of the latest technological events

Learn

128 How to... import bookmarks to Microsoft Edge

129 How to... Recover deleted files

130 How to... Manage boot devices

132 Business Help

Our expert answers all your software queries

134 Helpfile

Step this way for all your hardware and Windows problems

136 Advanced Projects

Make an Arduino-powered PC fan controller

139 Multimedia Expert

Follow **Ben Pitt**'s expert guide to taking breathtaking photos

143 App Creative

We reveal the best kids' creative apps

Features

96 Windows 10 Fixed

Things seem to have gone smoothly with the Windows 10 rollout, but there are some inevitable problems with the new operating system. In this month's feature we help you fix the most common Windows 10 foibles

104 The Sharing Economy

It promises to put consumers in touch with service providers and save them large amounts of cash. But is the sharing economy all good news, or is it a threat to your job?

112 Analogue Computing

Computers may not always be digital. Analogue computing was a big deal 50 years ago and it may be key to the computing challenges of the future, too

120 Cameron's Porn Block

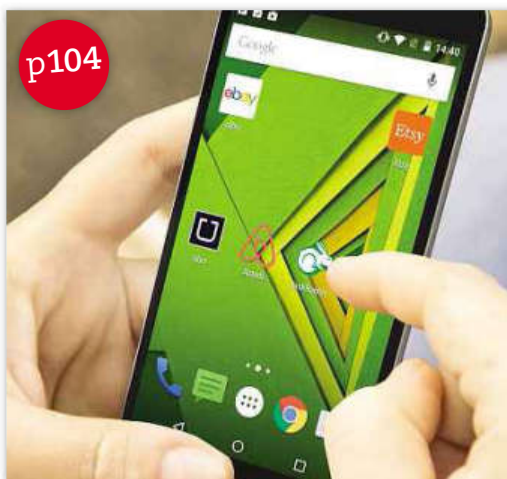
The government is determined to make adult sites put in place robust age verification checks. But is it really possible to protect our children from pornography? We find out

122 Run Linux on your Chromebook

If you want to turn your Chromebook into a proper computer, you need to install Linux on it. Follow our guide and you'll have Ubuntu up and running in a snap

124 Video streaming vs Blu-ray

We see if the convenience of renting films online comes at the expense of quality, as we use our HDMI frame-capturing kit to compare Amazon Instant Video to Blu-ray



Reviews

24 This month's hot product

Intel's Skylake CPU architecture has been years in the making, and it's finally here. We put the unlocked Core i5-6600K through its paces



26 PCs & Laptops

Scan's 3XS Z170 gaming PC has a state-of-the-art Intel Skylake processor, and it's a heck of a performer

32 Handhelds

Vodafone's Smart Ultra 6 (p36) is the new king of budget smartphones

38 Photography

High-quality 4K video recording gets a lot more accessible with Panasonic's G7 CSC

39 Displays

Samsung's U32E850R is ideal for photo editing, thanks to a stunning 4K PLS panel

40 Home Cinema

Epson's EH-LS10000 4K projector can upscale your 1080p Blu-ray discs too

46 Audio

Raumfeld's wireless speakers are an excellent addition to a multiroom sound system

48 Video

BT Sport UHD (p51) goes on air as the first 4K TV channel available in the UK. We've tested the service and the first compatible YouView box to see how it measures up

50 Networks

Netgear's Nighthawk EX7000 is one of the fastest Wi-Fi range extenders around

52 Printers & Scanners

After a new inkjet printer for your home office or work? We've reviewed four

54 Storage

Toshiba's Canvio Connect II is an inexpensive and stylish portable hard disk

56 Components

We put Intel Z170 motherboards from Asus and MSI to the test this month to see which one you should pair with a Skylake CPU

60 Software

We give our final verdict on whether Windows 10's new features make it worth the upgrade

62 Games

Frozenbyte's puzzle platform series makes the jump into 3D with Trine 3

64 Best Buys

All the best kit we've reviewed recently

72 How We Test

Our comprehensive tests and awards explained

Group Test

78 Windows 10 PCs

Windows 10 has now been out long enough for PC manufacturers to build systems perfectly suited to the new OS. The models we've gathered for our group test this month are all just right for Windows 10, with up-to-the-minute processors, loads of storage space and excellent graphics cards, and can be yours for just £600



74 Your software*

Scan your system for outdated drivers, then download and install any updates with just a single click, using the powerful yet easy-to-use Driver Booster 2

6 FULL PACKAGES



* FREE SOFTWARE EDITION ONLY

NOVEMBER 2015 | COMPUTER SHOPPER | ISSUE 333

Windows 10 download. It will take most of our monthly allowance. I thought I could shortcut the process, download the ISO and save some of that allowance by using the ISO to update all the computers.

A little research led me to the 'Media Creation Tool'. This doesn't work! (Setup couldn't start; please reboot, etc). Further research led me to some links that would allow the direct download of the ISO. My first attempt using Free Download Manager halted at 80% then wouldn't restart. My second attempt got to 98% before stalling. Microsoft then appeared to pull the plug on those links as they now don't work at all (each attempt took over 24 hours).

Back to my research. It would appear the only way I can directly download the ISO is to pretend that my computer is a mobile phone! I feel that in its attempt to be clever, Microsoft is just alienating its customers.

Would it not have been simpler to distribute discs – perhaps in *Shopper*?

Tony Leighton

We agree that one of the most frustrating aspects of upgrading to Windows 10 is that there's not a simple 'download' link for the ISO, and that Microsoft's web page insists on redirecting you to the Media Creation Tool. It sounds like your problems were also multiplied by the massive demand for Windows 10 downloads around the launch.



⬆ If you want a Windows 10 disc image, the Media Creation Tool is both a blessing and a curse

Microsoft isn't about to let *Shopper* distribute Windows 10 any time soon, but there is one workaround; use a Mac or Linux computer (or a live Linux USB drive) to go to the Windows 10 download page. This will let you download Windows in the normal way, rather than you having to use the Media Creation Tool.

READ THE SMALL PRINT



A year ago I bought an Asus Transformer Book with Windows 8.1. After setting it to start at the desktop rather than the Start screen, I did not have any significant problems using this alongside my XP netbook and Vista desktop.

In June, after reading the review of the Acer Revo One in *Shopper*, I decided it was time to retire Vista and go to Windows 8.1 for my main desktop machine. When the Windows 10 reservation icons appeared on both 8.1 machines, I placed a reservation on the Revo, but as the Transformer Book has only a 32GB SSD and Asus couldn't confirm that it would stand up to the Windows 10 upgrade, I uninstalled update KB3035583 and

hid the update, which removed the Windows 10 reservation icon from the Transformer Book.

In July, I installed a USB TV tuner and paid £100 to upgrade to 8.1 Pro with Windows Media Center (WMC). I used WMC for my TV and PVR activity in Vista and found it one of the best TV packages available. At the end of July, the Windows 10 compatibility tool was updated to add the warning that WMC would be removed during the upgrade.

I did some searches on Microsoft.com and found a couple of very dubious reasons for not offering WMC in Windows 10. The fact that few people use WMC for watching DVDs was the first excuse. Second, Microsoft didn't want to include the licence costs of the codecs for WMC in Windows 10. But I've already bought an upgrade to install WMC, and presumably the codecs. Why should I lose these facilities I've already paid for?

Richard Taylor

The removal of Windows Media Center is controversial; it may not have been used by that many people, but there simply aren't any replacement applications as polished or easy to use. It's particularly galling if, as in your case, you've paid for an upgrade to get WMC.

As mentioned above, if you do upgrade to Windows 10 and need a media centre application, you can try MediaPortal. If you really need Windows Media Center, it's best to stick with Windows 7 or 8.



CONNECTION PERFECTION



Special Offer for Computer Shopper readers
10% OFF All Cables & Adapters
 at lindy.co.uk use code: **CS10**


LINDY®

The IT & AV
CONNECTIVITY
SPECIALISTS

www.lindy.co.uk

Offer valid for 30 days after publication or while stocks last. Offer is applicable to website orders only by consumer customers. Not valid for LINDY trade account customers. Offer excludes delivery charges. LINDY Electronics cannot be held responsible for any errors or omissions.


THE OTHER OPTION

 In 'Group Test', *Shopper 332*, you make no mention of renting a DVD, Blu-ray or boxed set from a local library, usually very cheaply. Hertfordshire is my local authority and a selection of popular titles are available to rent at the same time as they appear in the shops. Priced at £2 to £3 for a week's hire, people should take advantage of them while they're still available.

Carol Palmer

That is an excellent suggestion. Make use of your local library before they all close.

PUSHED TOO FAR

 My wife recently experienced a major disadvantage of shopping in a physical store, rather than online: pushy sales staff.

She went into a Currys store and told an assistant she wished to buy a particular TV. The assistant recommended taking out an extended warranty at £2.50 a month, with the first two months free. He also said a 'special cable' would be needed that normally sold for £15, but to her, £10. No doubt the 'special cable', if required, could be bought in a pound store for, er, a pound.

My wife declined the extended warranty and the cable. As the assistant started to enter the details on the system, he said he'd added the extended warranty anyway, as it was free for two months and could then be cancelled. He clearly didn't know my wife as I do as, taking umbrage at his hard-sell tactics, she told him to cancel the sale and stormed out of the store. Later, we bought the same TV on Amazon for £10 less.

Bricks-and-mortar stores need to win over customers from the internet by offering great personal service. The pushy approach of this particular salesman served only to drive Mrs T away (and not to Currys' website).

Alan Thomas


Extended warranties are generally nonsense, and what the Currys salesman did was frankly rude.



↑ We would like all Currys salespeople to be this friendly

Physical shops do indeed need to compete on customer service – it seems to work for John Lewis.


PIE IN THE SKY

 I read your Sky story (*News, Shopper 332*) with amusement. Sky execs should try being a BT customer first before claiming BT gives its customers preferential treatment. When my broadband stopped working due to a lightning strike last year, its customer service reduced me to tears with the incompetent way they handled the incident and the frustration of broken promises. After the engineer failed to turn up for an appointment, the line was eventually repaired 10 days after the failure. The official story from BT was that there was unprecedented demand for repairs, but when talking to the engineer he blamed understaffing and preferential treatment to non-BT customers (including Sky).

Being forever optimistic I thought that this would be one-off. After all, when I lived in a remote part of Yorkshire in the early 2000s the service from BT was good. But to my dismay I happened to be talking to a work colleague and BT customer who was also driven to tears of frustration by BT's customer service.

BT merging with EE looks like a marriage made in heaven: two companies with the worst track records for customer service join forces. Great!

Mark Paine

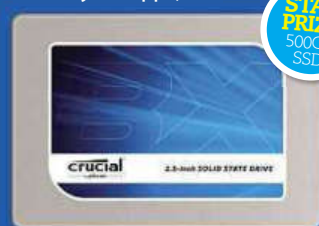
Our only hope is that the merger will form some kind of bad customer service singularity, at which point customers take to the streets in their thousands and Ofcom is forced to take action to avoid a wholesale breakdown in public order. 

WRITE IN AND WIN

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with the BX100 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

This fast SSD is 15 times faster than a hard disk, and will make your computer boot incredibly quickly and make applications faster to load. With 500GB of storage, there's plenty of room for Windows and all your apps, too.

STAR PRIZE
500GB SSD



PLUS

We're offering every reader who has a letter published and supplies their address a Computer Shopper 'Ranter' or 'Raver' mug.



NEXT MONTH

› WINDOWS 10 LAPTOPS

It's taken some time, but laptops ready for Windows 10 are finally on the way. To show off the new operating system's features, we've scoured the market for the best models, from power laptops to budget portables and clever touchscreen hybrids. Whatever your needs, we'll have the perfect laptop for you



› WHERE'S MY SMART HOME?

Despite all the hype, people have yet to open their hearts and wallets to the Internet of Things. We find out why

› THE FUTURE OF MONEY

After decades of cash and card dominance, the way we pay is changing. We explain why the rise of Bitcoin and Apple Pay matters



› MOORE'S LAW AT 50

Was the famous computing power law a prescient prediction, or simply a target that the industry strived to achieve?

› DIY MUSIC STREAMING

Who needs Spotify, Tidal or anything else, when you can make your own music streaming service? We show you how



ON SALE
in newsagents from
15th October

Get a PC that's more **you**



Rutilus

- AMD Athlon X4 860K
- ASUS® A88XM-PLUS
- 8GB HyperX FURY RAM
- AMD Radeon R9 270X
- 120GB Samsung EVO 850 SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM **£549***



Vanquish HAF III

- Intel® Core™ i5-4590
- ASUS® H81-Gamer
- 8GB HyperX FURY RAM
- 2GB NVIDIA® GeForce® GTX 960
- 120GB Kingston SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM **£749***



Minerva

- Intel® Core™ i5-4690K
- ASUS® RoG MAXIMUS VII RANGER
- 16GB HyperX FURY RAM
- 4GB NVIDIA® GeForce® GTX 970
- 120GB Kingston HyperX 3K SSD
- 2TB Hard Drive
- Windows 8.1
- 3 Years Warranty

THIS SPEC FROM **£999***



Ultimate Ti

- Intel® Core™ i7-5930K
- ASUS® Rampage V Extreme
- 32GB HyperX PREDATOR RAM
- 6GB NVIDIA® GeForce™ GTX980Ti
- 6GB NVIDIA® GeForce™ GTX980Ti
- 240GB HyperX SAVAGE SSD
- 1TB Western Digital Black Hard Drive
- Windows 8.1
- 3 Years Warranty

THIS SPEC FROM **£2,999***



Optimus Nebula

- Intel® Core™ i7-4720HQ
- 17.3" Matte Full HD LED
- 8GB HyperX IMPACT RAM
- 2GB NVIDIA® GeForce® GTX 960M
- 120GB HyperX 3K SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM **£849***



Defiance 17

- Intel® Core™ i7-4720HQ
- 17.3" Matte Full HD LED Screen
- 16GB HyperX IMPACT RAM
- 4GB NVIDIA® GeForce® GTX 980M
- 240GB Kingston SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM **£1,349***

USE DISCOUNT CODE **CS15P** FOR £15 OFF YOUR ORDER

GAMING DESKTOPS & LAPTOPS
www.pcspecialist.co.uk • 0333 011 7000

Security complex

He's no expert, but **David Robinson** believes his security arrangements are good enough to keep him safe from viruses and malware



DAVID ROBINSON
Software and systems developer
letters@computershipper.co.uk

IN ISSUE 330 I described the shenanigans that arose from an attempted scam on my Visa credit card, which led reader Paul Morris to write a letter that appeared in issue 331. Paul raised a number of issues that are worthy of further comment.

Now, despite what some readers may think, I'm not a computer expert. Nor is anyone else. The subject is simply too diverse for anyone to be an expert in but a small fraction. There are bits that (I think) I know plenty about, other bits that I know just enough of and vast expanses that are probably as much a mystery to me as to any other layperson. I'd put detailed knowledge of computer security in the last category.

Paul and I agree on much, including a hatred of offshore 'help' and voice recognition nonsense. The bit that needs some examination is: "I am very surprised that as David is a software and systems developer that he relies only on Rapport, Windows Defender and Malwarebytes to protect his computer from any security threats. Rapport seems to have a bad reputation for protection from looking at reviews online

someone who wants to access your online account illegally. It's not meant to replace anti-virus.

The worst criticism I can find of Rapport is at tinyurl.com/UDRapport. A weakness occurred in 2011 and was fixed before IBM shelled out the \$1bn. You can imagine the conversation at IBM:

"Hey, Hank," says IBM's CEO to VP of acquisitions, "is this Trusteer thing I'm paying for any good?"

"Well, Trusteer tells me it is," says Hank hopefully.

More likely, the conversation went something like this: "Our asses are on the line here, Hank. What assurances have we got?"

"Well, Mr Big, we have three independent reports from external testing labs, and they have professional indemnity insurance for \$1bn and their insurers have commissioned separate tests and the testers have PI insurance with people who've done tests. So your big fat ass is covered and if it isn't we sue the ass off of the testers."

Well, maybe he didn't say the last bit, but you get the picture and that's the way it works on deals much smaller than \$1bn. In addition, if Rapport was so easy to break, you'd expect internet forums and ambulance-chasing lawyers to be all over it, suing asses. An hour of Googling reveals no evidence of it.

DEFENDER DEFENDED

On to Windows Defender. Regular readers will know that I'm no Microsoft apologist. When Microsoft killed our last Lenovo laptop with a bad update (now there's a threat that's hard to defend against) the replacement model came with McAfee pre-installed. It was awful. The computer was so slow as to be unusable. So I removed it and, as a quick replacement, installed Defender, which I've not got round to replacing.

T'internet has millions of comments on the quality of Defender (see *PC Mag's* review,

tinyurl.com/UDDefender). It's worth reading the section where Microsoft says its product is good when exposed to 'real-world' threats, as opposed to the kinds of threats that testers use.

Finally, to Malwarebytes. The main reason I have it installed is for its ability to clean out anything suspicious (see tinyurl.com/UDMalware). Not that I have to do that often on my own system. It made short work of the stupid Superfish thing that came pre-installed on my Lenovo (tinyurl.com/UDSuperfishmalware) while the still-installed McAfee proved totally ineffective.

CARD TRICK

Much of this is beside the point. As I said in issue 330 I'm certain the card problem wasn't the result of keylogging or malware infestation. If that had been so the Visa account would have been hit quickly for a large sum right away. I suspect the bad transaction was placed through a site with poor credentials-checking. And the helpdesk's 'someone tried to change your date of birth' was irrelevant because (a) the DOB isn't part of their security credentials and (b) they didn't succeed.

Paul's point about the PIN sentry type of system is a good one. My bank uses a similar system, not for logging in, but for authorising payment to any new payees. The downside of using hardware to strengthen logins is that you're stuck if you don't have the device with you. I could install stronger antivirus but at the potential cost of computing speed. As the last virus I had on a PC was in 1988 and the last downloaded malware was in 2009, I'm happy to stick with the 'if it ain't broke, don't fix it' approach.

Thanks once again to Paul for a thought-provoking letter. As for you, readers – don't necessarily do what I do; make up your own minds to fit your own circumstances. **CS**

If Rapport was so easy to break, you'd expect ambulance-chasing lawyers to be all over it

and is limited in its scope, while the other two programs are just not up to the task."

'Systems developer' (implying 'expert'), we've dealt with. No superhero here, I'm afraid.

Trusteer Rapport started life in 2006 and was bought by IBM in 2012 for \$1 billion. It's distributed worldwide free of charge to customers by many major banks and its main aim is to prevent keylogging and screen capturing, so your account credentials can't be relayed to

mesh

FROM EVERYDAY TASKS TO EVERY GAMERS DREAM

Find your ideal PC at www.meshcomputers.com

New
Windows 10
ON ALL PCs



New Intel Skylake
6th Generation
Processors



Full specifications of all
Mesh PCs and Laptops
are available online

Elite Inspire | £399
Inc. VAT & Delivery



- Intel® Core™ i5 4460 Processor
- MSI H81M-P33 Motherboard
- Integrated Intel® Full HD graphics
- Fast 8GB DDR3 2133MHz Memory
- 1TB Hard Drive
- Stylish Brushed Aluminium Effect Case
- New Microsoft Windows® 10
- Lifetime Gold Warranty*

Award winning Elite Pro | £599
Inc. VAT & Delivery



- Intel® Core™ i5 4690 Processor
- MSI B85M-E45 Motherboard
- 2GB NVIDIA GTX 750Ti graphics card
- Fast 8GB DDR3 2133MHz Memory
- 1TB Hard Drive
- 120GB Patriot Blaze SSD
- Corsair Carbide Mid Tower Gaming Case
- New Microsoft Windows® 10
- Lifetime Gold Warranty*

Elite Skylake | £999
Inc. VAT & Delivery



- New Intel® Core™ i5 6600K Processor
- MSI Z170A PC MATE Motherboard
- 4GB NVIDIA GTX 970 graphics card
- Fast 8GB DDR4 2400MHz Memory
- 1TB Hard Drive
- 120GB Patriot Blaze SSD
- IN Win 703 Mid Tower Gaming Case
- New Microsoft Windows® 10
- Lifetime Gold Warranty*



FREE GAME
• METAL GEAR SOLID V
The Phantom Pain

Elite Skylake Pro | £1199
Inc. VAT & Delivery



- New Intel® Core™ i7 6700K Processor
- MSI Z170A PC MATE Motherboard
- 4GB NVIDIA GTX 970 graphics card
- Fast 16GB DDR4 2400MHz Memory
- 2TB Hard Drive
- 240GB Patriot Blaze SSD
- ZALMAN Z11 Neo Luxury Gaming Case
- New Microsoft Windows® 10
- Lifetime Gold Warranty*



FREE GAME
• METAL GEAR SOLID V
The Phantom Pain

15.6" Mesh V3-CF1 | £759
Inc. VAT & Delivery



- Intel® Core™ i7-4710HQ Processor
- 15.6" LCD Full HD (1920x1080)
- 2GB NVIDIA GeForce GTX 950M
- 8GB DDR3 1600MHz Memory
- 1TB 7200rpm Hard Drive
- Wireless 10/100/1000 Gigabit Ethernet
- 5-6 Hours Battery Life
- New Microsoft Windows® 10
- Integrated HD Webcam, Sound Card, Microphone and SD Card Reader
- 2 Year Gigabyte Warranty

17.3" Mesh V4-HO | £1399
Inc. VAT & Delivery



- Intel® Core™ i7-5700HQ Processor
- 17.3" LCD Full HD (1920x1080)
- 6GB NVIDIA GeForce GTX 970M
- 16GB DDR3 1600MHz Memory
- 2TB 5400rpm Hard Drive
- 256GB SATA SSD
- Blu Ray Read/Write Optical Drive
- New Microsoft Windows® 10
- Integrated HD Webcam, Sound Card, Microphone and SD Card Reader
- 3-4 Hours Battery Life
- 2 Year Gigabyte Warranty



FREE GAME
• METAL GEAR SOLID V
The Phantom Pain

✉ sales@meshcomputers

☎ 020 8955 0731



www.meshcomputers.com

0% FINANCE - BUY NOW, PAY SEPT 2016

Terms and
conditions apply.

Now Accepting
PayPal

Please Read: Sales subject to terms & conditions (copy available on our website). Advert does not form part of a contract. Pictures shown for illustration purposes only - colours may vary. Full specifications available online. Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States and other countries. All trademarks are acknowledged. At Mesh our PCs are custom built, fully burn-tested with professional CPU overclocking options - Free overclock configuration is available for an unlocked CPU and when a liquid CPU cooler is selected. 0% Finance - Pay 10% deposit, and pay the rest off within 12 months and pay no interest. *Lifetime Gold Warranty - Lifetime Labour, 2 Year Parts, 1 Year Free Collect & Return. Sales line open Monday - Friday 9am - 6pm. Online ordering 24x7. Prices and specification correct at time of going to press on 31/8/15. E&OE.

Zero intolerance

Two recent high-profile cases have confirmed some of **Gordon Holmes's** worst fears about zero-day exploits and the internet of things. Don't say he didn't warn you...



GORDON HOLMES

With more than 30 years of experience in law enforcement, our retired cop gives a police officer's perspective on the sticky subject of cybercrime
letters@computershopper.co.uk

REGULAR READERS will know of the wide range of topics covered by this column over the years, all with a central theme of cybercrime. However, there have been a couple of recent columns that have had a predictive quality that even I couldn't have anticipated.

In *Shopper 331*, you may recall that I asked for readers' opinions on a demonstration I'd witnessed and had felt particularly uncomfortable about. Although I didn't mention the company that had presented its services by name, the product being demonstrated used zero-day exploits to infect targeted devices. This allowed the company to perform detailed and intrusive surveillance on any machine, mobile or desktop, irrespective of its operating system. Substitute 'person' for 'machine' and you have the reason for my disquiet.

So I fought hard to contain any feelings of *schadenfreude* when I read that a 400GB data dump of documents and emails belonging to the Hacking Team had been published on Wikileaks. This was the company I'd had

to discover zero-day exploits and use them to gain access to targeted devices via the related vulnerable program.

The fallout from the Hacking Team being hacked has been seismic in the security industry. First, details of the Adobe Flash zero-day vulnerability it had been using were plastered over various public forums for all to see. Adobe obviously took this very seriously and rushed to patch its software, but I can't help wondering if there was an opportunity before the patch was issued for criminal groups to take advantage of a 'free' vulnerability, using it for their own nefarious ends.

Some of the regimes that had allegedly been sold the Hacking Team's surveillance program had questionable human rights records, and some were even subject to western sanctions. This caused a number of financial institutions to perform a quick inventory of their records to ensure they hadn't facilitated financial transactions between the Hacking Team and countries on the sanctions list, for fear of being labelled sanctions busters.

ZEROS AND VILLAINS

There can be no doubt that tools such as this are so effective thanks to researchers who discover zero-day vulnerabilities, but then don't follow responsible disclosure by informing the program vendor so the problem can be patched.

The growth of this industry is evidenced in a recent blog by Yahoo!'s former chief information security officer Ramses Martinez, who provided some interesting statistics on Yahoo!'s 'bug bounty' program – the reward paid to researchers that discover and disclose new zero-day vulnerabilities. He states that Yahoo! has paid out over \$1 million in rewards for verified software bugs. Of 10,000 reported bugs, 1,500 were verified and resulted in a payout.

The big vendors are taking the issue of fixing bugs very seriously, but this still leaves a large chunk of the research industry testing programs to destruction, discovering vulnerable flaws and keeping the information to themselves; or worse, selling them to the highest bidder. I'm told by those in the know that nation states are the biggest purchasers of zero-day vulnerabilities, which makes me very uncomfortable.

DRIVES ME CRAZY

Now to my second prescient column. In *Shopper 329*, I wrote about the new acronym on the block, IoT (the internet of things), and the fact that security in many of our ever-increasing internet-connected devices was no more than a second thought for most manufacturers.

So how about internet-connected cars? You may have read of the two hackers who took complete control of a Jeep Cherokee through its entertainment system from 10 miles away, using a laptop connected to the internet and deploying what has been described as a zero-day exploit. Yes, you read that correctly, a zero-day exploit.

After deploying this particular exploit, the hackers were able to control all the vehicle's functions, including its radio, air conditioning and, crucially, its acceleration and brakes while the vehicle was being driven by a journalist who was a part of the experiment. Fiat Chrysler is now recalling 1.4 million vehicles in the US so the software can be patched. So much for secure IoT.

I wouldn't want you to think that I'm claiming any special precognitive powers. It's just that, given the subjects I've spoken of in the past, these outcomes were, in my opinion, inevitable. And I get the feeling that we haven't seen the last of them, either. **CS**

I'm told by those in the know that nation states are the biggest purchasers of zero-day vulnerabilities

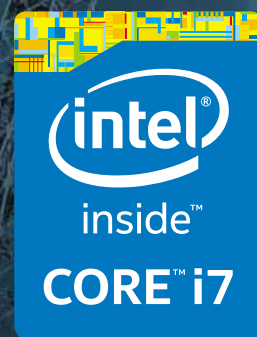
contact with and, although the individuals presenting gave assurances that their product was offered only to responsible law-enforcement organisations allied to accountable regimes, the hacked data appeared to show that this was not always the case.

I wasn't happy with a commercial company touting what appeared to be a bespoke and almost foolproof method of spying on anyone in the world. I was even less happy about the methods it employed, which was

Cyberpower recommends Windows



Create the PC of Your Dreams



To Custom Build Your Ideal Desktop or Laptop, Visit :
www.cyberpowersystem.co.uk
0844 371 2727

Infinity X3 Windows 10

Great Value for Money Home PC with Water Cooling
 ASUS® H81M-P Mainboard
 8GB Kingston HyperX Fury 1866Mhz DDR3 Memory
 2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
 2GB NVIDIA® GTX 750Ti video card
 CoolerMaster HAF 912 Gaming Case
Corsair H55 Cooling System
 LCD monitor is not included but optional

Intel® Core™ i7 Processor
 4790K 3.6Ghz £ 795
 4790 3.5Ghz £ 769

Intel® Core™ i5 Processor
 4690K 3.4Ghz £ 705
 4690 3.4Ghz £ 689
 4590 3.2Ghz £ 665

Intel® Core™ i3 Processor
 4370 3.6Ghz £ 619
 4170 3.4Ghz £ 589

From **£ 589** Inc VAT and Del



Card Reader

Infinity X5 Windows 10

Gigabyte® Z97-HD 3 with SATA III, USB 3
 8GB Kingston HerperX Fury 1866mhz Memory
 2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
 2GB Nvidia® GTX 960 Graphic Card
 NZXT Phantom 410 Mid Tower White
Corsair H55 Cooling System
 LCD monitor is not included but optional



Intel® Core™ i7 Processor
 4790K 3.5Ghz £ 939
 4790 3.4Ghz £ 909

Intel® Core™ i5 Processor
 4690K 3.4Ghz £ 845
 4690 3.4Ghz £ 829
 4590 3.2Ghz £ 809

From **£ 809** Inc VAT and Del



FANGBOOK EGDE S 4K Windows 8.1

Gaming Laptop with 4th Generation
 Intel® Core™ i7-4720HQ Mobile Processor
 Intel® HM87 Chipset
 WiFi Link 802.11 A/B/G/N Wi-Fi + Bluetooth Combo
 16GB DDR3 1600 SODIMM Memory
 1TB 5400RPM SATA HDD
 15.6" 4K UHD 3840 x 2160 Display
 2GB Built-in Nvidia® GeForce® GTX 965M Video Card
 Built-in FHD Webcam, 1 HDMI Port



Intel® Core™ i7 Processor
 4720HQ £ 999

From **£ 999** Inc VAT and Del



Intel® Core™ i7 Processor
 Extreme Edition
 i7-5700HQ £ 949

FANGBOOK III BX6-200 Windows 8.1

Gaming laptop with 5th Generation
 Intel® Core™ i7-5700HQ Extreme Mobile Processor
 Intel® HM87 Chipset
 Intel® Dual Band Wireless-AC
 3160 802.11AC Wi-Fi + BT 4.0 combo
 8GB DDR3 1600 SODIMM Memory
 120GB Kingston SM2280 S3 SSD
 1TB 5400RPM SATA HDD
 15.6" Full HD 1920 x 1080 Display
 2GB Built-in Nvidia® GeForce® GTX 960M Video Card
 Built-in 720P HD Webcam

From **£ 949** Inc VAT and Del



- Free UK delivery*
- All desktops come with 3 year warranty**
- Flexible finance available and secure online payment

*UK mainland only, see our website for detail
 **See our website for detail

Unleash The Power

NVIDIA®, nForce®, GeForce®, SLI™ are trademarks or registered trademarks of NVIDIA Corporation or its subsidiaries in the United States and other countries. CyberPower PCs use genuine Microsoft® Windows® • www.microsoft.com/privacy/howtotell
 Celeron, Celeron Inside, Centrino, Centrino Inside, Centrino Logo, Core Inside, Intel, Intel Core, Intel Core Inside, Intel Inside Logo, Intel Viv, Intel vPro, Itanium, Itanium Inside, Pentium, Pentium Inside, Viv Inside, vPro Inside, Xeon, and Xeon Inside are trademarks of Intel Corporation in the U.S. and other countries. All prices are subject to change without notice or obligation. CyberPower is not responsible for any typographical and photographic errors. Copyright ©2008 CyberPower. All rights reserved.

RANTS & RAVES

Power holds little appeal for the Shopper staff, as Katharine opts for less, Tom chooses smaller and Mel wrestles with responsibility for all the ills of the human condition

Katharine Byrne

RAVES

Smartwatches seem pretty dumb, thought Katharine, until she found one that gets more done by doing less

LET'S FACE IT, smartwatches are a bit rubbish. Once hailed as the next must-have gadget, these wrist-worn computers just don't seem to be catching on. Admittedly, I think they're a pretty hard sell. When people practically have their phones surgically attached to their hands, having something else doing the same thing on your wrist seems a little superfluous.

Many people spend a lot of money on watches with a view to them lasting for 20 years or more – something that smartwatch manufacturers don't seem to have realised. LG has already released several iterations of its G Watch wearable, for example, and Apple will no doubt release Watch 2.0 within the next year. Smartwatches, like phones, are in danger of looking out of date very quickly without even going through an appealing retro phase like your 1972 Omega.

For women they're even worse, as every smartwatch I've strapped to my wrist just looks ridiculous. The LG G Watch R, for

instance, is wider than my wrist, and the Moto 360 just gets caught on my coat and cardigan sleeves. They're big, cumbersome things that don't fulfil any practical need, and I was all but ready to give up on smartwatches altogether. Until, that is, I started wearing the Huawei TalkBand B2.

The best thing about the B2 is that it isn't even a smartwatch. Although it does indeed tell the time, it's actually a Bluetooth headset disguised as a fitness band. This gives it a number of advantages, not least of which are some seriously dinky proportions. At 22mm wide and 12mm deep, it doesn't dwarf my wrist the way other smartwatches do, and its meagre 31g weight means it doesn't feel like a lead weight when I wear it at night to track my sleep patterns. What's more, the detachable Bluetooth headset, which pops off the main strap, means I can actually stick it in my ear and answer calls without looking like a distinctly sub-par Dick Tracy.



There are several things the B2 doesn't do, such as push emails or texts to my wrist, but then I've never found this particularly useful on other watches I've tried simply because most of the time you still have to dig out your phone to reply to them anyway. There's also no heart-rate monitor to accompany the TalkBand's pedometer, but so far I've found its calorie and step counting to be relatively accurate based on data from other, more feature-heavy, wearables I've worn in the past. It also has a fairly decent battery life of around two-and-a-half days between charges.

And for me, that's enough. I don't need it to do anything else. I don't need a fancy circular screen, and I certainly don't need a near-continuous buzzing on my wrist from endless messaging and social media notifications. There will no doubt be many more smartwatches to come, but until one of them beats my back-to-basics TalkBand, I'm simply not interested.

Mel Croucher

RANTS

He may have kicked off the UK's video games industry, but Mel's not responsible for murder, psychedelic drugs or global terrorism

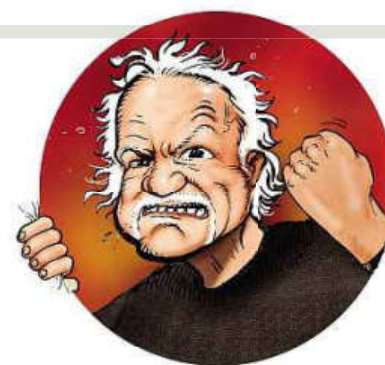
ACCORDING TO THE history books, the first dedicated UK video games company was founded on 19th November 1977. By me! I'm not entirely convinced I was responsible for the birth of this hugely lucrative industry, mostly because my bank balance shows no evidence of it. But if I really was midwife to such a monster, it's only natural that I must react when my creation gets slagged off. And these days it really does get slagged off. Monstrously.

Recently, specific games have been cited as the direct cause of urban riots (Grand Theft Auto), the murder of prostitutes (Carmageddon), teenage suicide (Call of Duty), paedophilia (Silent Hill 3), race riots (World of Warcraft), high-school massacres (Doom), random homicide (Manhunt), psychedelic drug abuse (Super Mario Brothers) and global terrorism (Arma 3).

According to expert research, video games are also responsible for schizophrenia, repetitive strain injury, acne, epilepsy and blindness. That's a

familiar list, is it not? In the days of my youth, the same maladies were blamed on rock'n'roll. In Victorian times they were all reckoned to be caused by overenthusiastic masturbation. And before then, these afflictions were blamed on witches, wizards, demons, evil spirits and redheads. In other words, the various conditions of humanity have always existed, they always will, and they have nothing to do with the spawning of video games by the cock-eyed optimist that was me back in 1977.

Toss a bunch of university researchers enough funding and they're guaranteed to come up with a link between video games and any physical or social malady you like. Toss another bunch of university researchers enough funding and they're guaranteed to prove the exact opposite by showing how video games cure the very same malady. A few weeks ago, a team at the University of Montreal proved that video games can cause Alzheimer's. At the same time a team at the University of



California proved that video games can cure Alzheimer's. Duh! Toss me enough funding and I will come up with empirical proof that Catholic women who don't shave their legs are murderers. It's all piffle, of course.

Some years ago a 28-year-old South Korean man collapsed and died in an internet cafe in the city of Daegu. The man hadn't slept, eaten or gone to the toilet for 72 hours because he was too engrossed in the video game Starcraft. The press sensationalised this sad story by blaming his death on the video game because it was obviously addictive and so it was evil. But of course this tragic death was not the fault of Starcraft. It happened because the man had a psychological problem and a weak heart. Video gamers can drop dead during a gaming session, but most do not. Hairy Marys can be murderers, but most are not. I didn't give birth to a monster; I was midwife to a few innocent entertainments. But what I did do was launch them into this real world of monsters.

Tom Morgan

RAVES

Tom's mission to build the tiniest gaming PC possible was foiled in the past by the huge power bricks required, but not any more

I'VE BEEN A fan of tiny PC builds for a while now. Anyone can slap a motherboard, a massive processor cooler, an oversized graphics card and enough cooling fans to chill a penguin into a full tower case, but it takes skill and careful component selection to squeeze the same power into a chassis small enough to fit under your TV.

Component manufacturers are gradually getting into the 'smaller is better' mindset, with tiny cases, Mini-ITX motherboards, low-profile memory and powerful yet compact graphics cards. The part that gets less attention is the humble power supply.

The standard ATX PSU is a sizable brick that takes up a large part of any build.

There is an alternative, however: the SFX power supply. These conform to the same specifications as regular ATX PSUs and yet can occupy less than half the space, leaving more room for airflow and, depending on the case, a larger graphics card or CPU cooler. An SFX PSU also opens the possibility of using a smaller case. I recently switched from a microATX case to a Mini-ITX box less than half the size while keeping almost all the components the same – I only had to swap my motherboard.



There are really only two companies that make SFX PSUs: Be Quiet! and SilverStone. Be Quiet!'s don't have modular cables, so you need to find room in the case for wires you aren't using, and they're limited to just 400W. SilverStone's modular SFX PSUs provide up to 600W, which is enough for an overclocked Intel processor, a water-cooling loop, multiple SSDs and a powerful Nvidia GeForce GTX 980 graphics card.

So there it is – a PC more powerful than any console in a case the size of a shoebox – and it's all thanks to innovation in the least showy of components: the PSU. **CS**

Microsoft unveils new E-Ink keyboard for Windows shortcuts

MICROSOFT HAS UNVEILED a novel new keyboard design that sees the Windows Start menu and other functions transferred to an E-Ink screen that sits above the regular QWERTY keys. The design could conceivably be used on devices such as the Microsoft Surface, allowing the limited screen space to be devoted entirely to apps rather than menus.

The DisplayCover is a letterbox-shaped, touchscreen E-Ink panel that has many different functions. When the user is on the Windows desktop, for example, the screen displays tiles for installed applications, allowing users to open Word, Skype and Windows Explorer without having to access the regular Start menu or taskbar.

When apps are opened, the DisplayCover hosts shortcuts or menu items for that specific application. In Photoshop, for instance, it allows the user to select different brushes without having to bother with the application's toolbars, which are often fiddly to use on small tablet-sized displays.

The E-Ink panel can even be used to run applications itself. Microsoft released a video showing someone sending an email from the E-Ink screen while they had a Skype conversation running full-screen on the LCD display, meaning they don't have to interrupt or resize their video call to send a message.

The DisplayCover also doubles as a large touchpad, allowing users to pinch and zoom



↑ With the taskbar effectively reassigned to the keyboard, the DisplayCover allows your onscreen applications to take pride of place

when viewing maps or horizontally scroll across the page using a two-fingered swipe. The DisplayCover accepts handwriting input from a stylus as well, meaning users can write on a flat surface rather than at an awkward angle on the screen itself.

The 1,280x305-resolution DisplayCover is currently just a working prototype dreamed up by the Microsoft Applied Sciences Group. It's almost certainly too embryonic to make it into the Surface Pro 4, due out this autumn, but it's a concept to keep an eye out for.

Virgin Media to give customers public Wi-Fi

VIRGIN MEDIA BROADBAND and mobile customers will soon be able to access free Wi-Fi in public places around the UK as Virgin harnesses its customers' Super Hub and Super Hub 2 routers as Wi-Fi hotspots, allowing users to get online without eating into their mobile data.

Starting this autumn, Virgin Media will enable hundreds of Super Hubs to create new Virgin Media Wi-Fi areas across the UK, including city centres, airports and the streets near your home. It's a similar idea to BT FON, which currently lets BT customers get online by using a small portion of other BT members' BT Home Hub or wireless router's bandwidth to turn it into a BT wireless hotspot.

Like BT FON, Virgin Media Wi-Fi will use a separate connection to your own personal Super Hub, so you don't need to worry about strangers hijacking your network or slowing down your streaming speeds. "The broadband you love and pay for will stay exclusively yours – and remain just as secure," Virgin Media said on its website.

"Virgin Media Wi-Fi uses a separate, additional internet connection on your Super Hub to the one used by your home broadband network," Virgin added. "This keeps the data from your home network completely separate from Virgin Media Wi-Fi traffic. A user of Virgin Media Wi-Fi can't see anything on

the in-home broadband network, nor can someone using the in-home broadband network see a Virgin Media Wi-Fi user's activity. There is also a separate content-filtering policy for Virgin Media Wi-Fi which doesn't affect your Web Safe settings in the home."

Virgin says download speeds will vary from area to area, but stated that customers "can expect to enjoy speeds similar to those that [they] enjoy at home."

To access the service, Virgin Media broadband customers will need to opt into the service and download Virgin's new dedicated app on their phone to get online when they're out and about. Once they've set up the service through their My Virgin Media profile settings online, they'll be able to register up to seven devices they can use on the move, and each one will automatically connect to the nearest in-range Super Hub. All you need to do is sign in and you're ready to surf the web.

Customers who don't want their routers to be used in this way can opt out of the service, but they won't be able to take advantage of the free Wi-Fi.

✦ If you don't want your Virgin Super Hub to be used as part of its Wi-Fi scheme, you can opt out of the service through your My Virgin Media profile settings online



Sky boosts movie features with Sky+ HD update

YOU CAN'T ACCUSE Sky of sitting on its laurels and not updating its main product, as it has released another improvement to its Sky+ HD box. This time, it's about improving Sky Movies, with the company adding a range of new features to make the service easier to use.

First up is the More Like This feature, which gives recommendations based on the title you're watching. Customers can just hit the yellow button on their remote to bring up the new details. It's a neat way of getting more from your box and adds a feature that's already common with streaming-movie services.

You can also now build your own Watch List, saving titles that you're interested in as you discover them. A click of the green button does the job quickly. Again, it's a feature that already exists with a lot of streaming services, such as Netflix, but it's an important one to have, as it means you can quickly start watching something you want to watch, rather than ploughing through the guide.

Customers in Italy have had the Watch From Start tool for a while, but it now makes its appearance in the UK. If you find a film that has already started on one of the movie channels, you can just tap the green button and the film will be downloaded to your box, so you can start watching it. Sky's on-demand service downloads the broadcast-quality show, so you don't have to suffer inferior quality for the sake of

convenience. Later on in the year, the company will roll out Rotten Tomatoes scores, so you'll have a better idea of what's worth watching, too.

Sky has started to roll out the new update now and has promised that it will be available to everyone later this autumn. As usual with these updates, your box will download and complete the upgrade automatically, provided that it's powered on.

➔ One of the biggest features in Sky's new update is the ability to create your own Watch List so you can save films to watch later



iPlayer introduces Live Restart

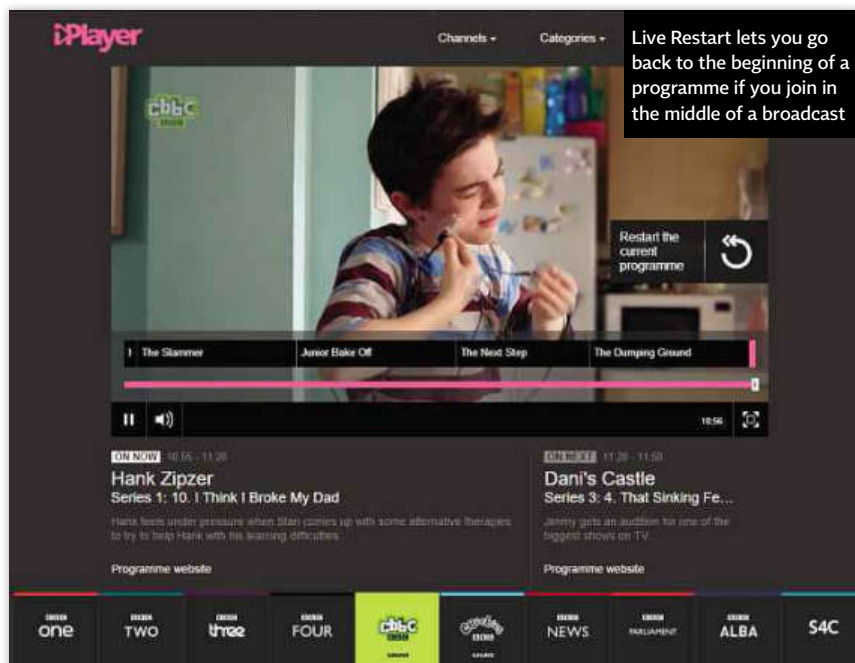
THE BBC IS bringing a raft of new features to iPlayer, including Live Restart across almost every device and the ability to pick up where you left off on different devices. The revamp of the catch-up service sees many features that have been available on the desktop version of iPlayer brought to set-top boxes, consoles and mobiles.

Live Restart was first introduced to the iPlayer website during the 2012 Olympics, allowing you to start watching from the beginning if you joined mid-way through the broadcast. It's now being added to YouView, Roku, Sky's Now TV, Amazon Fire TV, the Xbox One and a "range of connected TV sets", as well as the iPlayer mobile and tablet apps "in the coming year". The BBC says it will be adding Live Restart to more "TV devices" throughout the year, with the Sky+ box and the Virgin

Media TiVo being the two most notable absentees from the current list.

A related but new feature is cross-device resume. This will allow you to start watching a show on one device, such as on your smartphone on the train home from work, and pick up where you left off on another device when you get home. This requires viewers to be registered and logged in to iPlayer on all their devices, and will initially be available on computers, tablets and mobiles, with TVs coming later.

My Programmes is also being brought to other platforms. This section keeps track of your viewing habits, informing you when new episodes of a series you're watching become available. This will be added to the iPlayer mobile apps this month and the TV platforms "in the coming year", according to the BBC.



Hisense launches £449 4K smart TV

HISENSE HAS JOINED the race to the bottom with its new 4K smart TV range starting at just £449.

The K321 TVs come in 40in, 50in and 55in sizes with prices set at £449, £599 and £699 respectively. The screens don't look too shabby on paper, with Hisense promising an 800Hz refresh rate, although whether this will translate to smoothly processed images remains to be seen; in our experience cheaper TVs often miss out on proper, smooth frame interpolation.

The K321 has HEVC support, which means 4K content streamed from the internet can be played on apps within the TV itself without needing an external 4K set-top box. Netflix and YouTube streaming will be available from launch, but Hisense says that BBC iPlayer and Amazon Instant Video will be added this autumn. It's a shame not to have these two popular services available from launch, but at least they're on the way.

The TV will work with 4K Blu-ray players and set-top boxes, thanks to its two HDMI 2.0 ports capable of receiving Ultra HD signals. There's also a single USB3 port for playing videos or for using the TV's built-in PVR service.

It will be interesting to see how these TVs stack up against the competition. We'll bring you a full review as soon as we get our hands on one.



Nvidia and EE recall exploding batteries

NVIDIA HAS RECALLED some of its Shield tablets after it found that the battery could overheat and pose a potential fire hazard. The recall affects all Wi-Fi and LTE Shield tablets sold between July 2014 and July 2015, with Nvidia promising to replace the affected tablets free of charge.

Customers are being asked to stop using their tablets and to submit a claim for a replacement device, which they will receive after registering for the recall. To see if your tablet is included in the recall, you'll need to make sure your tablet is running the very latest software. To do this, you'll need to go in the Settings menu, tap About Tablet and select System Updates. In Kernel Version, it should be dated July 1st 2015 or later. If your system is out of date, you may need to update it multiple times.

The recall applies only to tablets with a certain battery type. To identify your tablet's battery, select Status in the About Tablet menu. Under the battery category you'll see either Y01 or B01. If it says B01, your tablet isn't affected by the recall. If it says Y01, the tablet will need to be replaced. Tap Y01 to launch the recall application on the device.

You'll then receive a notification on the tablet that includes your device's serial number, which you'll need to enter on Nvidia's website. You'll also need to include your name and contact information. Just remember to back up your data before you send your tablet back, as once it's gone, it's gone for good.

Nvidia wasn't the only company issuing a faulty battery recall last month, as mobile network EE also found itself having to recall half a million of its free portable EE Power Bar battery packs after a fault was



✦ You'll need to dive into the Shield's Settings menu to find out if your tablet is affected by the recall, as only those with Y01 batteries need to be replaced

found that puts customers in danger of an exploding battery.

Only specific batteries of the 1.5m Power Bars are affected, and can be easily identified with an E1-06 marking.

The issue was identified after a medical student from Aberdeen University suffered from lithium burns to her hands and damage to her bedroom carpet after the 4,500mAh lithium-ion battery inside her EE Power Bar combusted due to overheating.

EE has said it is "recalling batch E1-06 and requests that customers stop using them and return their device to a local EE store at their earliest convenience". You'll have to wait until EE has conducted its investigations before you can get a replacement, however. If your Power Bar isn't part of the E1-06 batch, you should be safe, with EE stating, "we've not seen any issues of overheating with other batches and they meet all safety standards".

Microsoft unveils Xbox One video recorder

MICROSOFT HAS ALWAYS had ambitions in the living room, but it's never got close to its goal of having a Windows machine in every room in your home. This could soon change, though, as Microsoft announced an incredibly rich PVR feature for its Xbox One console at the recent Gamescom conference in Cologne.

The PVR (or DVR as Microsoft calls it) will let you record live free-to-air TV via the digital tuner device it launched earlier this year. You'll have all the usual options to record individual

shows and set up series links, but it also has playback options that would make most PVR owners green with jealousy.

For instance, you'll be able to stream shows from your Xbox One to any Windows 10 device (desktop PC, laptop, tablet or even mobile phone) in your home via the Xbox app. Better still, you'll be able to download shows recorded on the Xbox One to any of those devices, so you'll be able to watch them on the go without an internet connection.

The Xbox One will record shows in the background without having an impact on gameplay or other activities. You'll be able to use Windows 10's Xbox app to schedule recordings on the go, so you'll never miss a show again.

Windows 10 will be running on Xbox One by the end of the year, so we should hopefully see Microsoft's DVR features arrive in early 2016. Of course, a games console with subscription-free channels isn't going to worry the likes of Sky or Virgin just yet, but when it already has good support from the likes of Netflix and other streaming and catch-up services, the addition of free-to-air TV recording could make an Xbox One a very tempting proposition for those after an all-in-one entertainment system.

Microsoft also announced that it would be boosting the quality of Xbox One game streams to Windows 10 devices, offering a new 1080p and 60fps Very High quality level over the default 720p setting. This comes as an update to the Xbox app for Windows 10, which also includes the ability to right-click friends' names and send them a message or invite them to an Xbox party. Games can now be organised into an alphabetically ordered grid as well, making it easier for those with a large gaming library to find the title they're looking for.



Xbox chief Phil Spencer revealed Microsoft's new DVR feature, which will let you record free-to-air TV channels straight to your Xbox One console



Google hopes its OnHub router will take pride of place in your living room

Google launches Wi-Fi router

GOOGLE HAS LAUNCHED its own wireless router, OnHub, promising to end the Wi-Fi dropouts and complicated setup procedures that it claims beleaguers other routers. Google's real motivation for launching the device, however, is to stake its claim in the emerging smart home market.

The OnHub is an attractive, cylindrical unit that's made by router manufacturer TP-Link. It looks similar to the D-Link DIR-868L, which was released a couple of years ago.

Despite the absence of any external antennas, Google claims the device will offer a fast and reliable Wi-Fi connection. The search giant claims a "unique [internal] antenna design and smart software keep working in the background, automatically adjusting OnHub to avoid interference and keep your network at peak performance". The router also offers automatic Wi-Fi channel switching and the option to prioritise traffic to a particular device, which are both fairly standard features on even the most rudimentary of today's routers.

What makes the OnHub stand out is support for Bluetooth Smart Ready and Weave. Bluetooth Smart Ready is a low-power version of the Bluetooth standard designed for the Internet of Things, while Weave is a wireless protocol used by the Nest range of smart thermostats and smoke alarms, which are owned by Google. The OnHub is therefore clearly intended to become the device at the centre of the smart home, with Google attempting to control the lot.

Google is also attempting to shift router management away from PCs and over to mobiles, with the OnHub controlled from an Android or iOS app, rather than through a web browser. The app keeps track of data consumption and helps users troubleshoot any connection problems that may ensue. It also reveals the network password, which can be texted or emailed to friends from your phone.

The OnHub router is currently only available in the US for \$199 (around £130), and Google has yet to announce any plans to bring the device to the UK.

Tesco launches first compact Windows 10 tablet

WE HAVE SEEN a flood of cheap Windows 8.1 tablets emerge over the past year or so, and now Tesco has released one of the first compact tablets to come pre-installed with Windows 10.

The Tesco Windows Connect has a fairly standard specification for a budget compact tablet. It has an 8in 1,280x800 resolution screen and runs on a quad-core 1GHz Intel Atom Z3735G processor paired with 1GB of RAM. It also has 32GB of built-in storage, which is a step up from the meagre 16GB afforded to most small tablets, and there's a microSD slot that can accommodate up to 32GB more.

However, its rear camera has only a meagre 2-megapixel sensor, so we don't expect you'll be using it take many pictures of important family



occasions. There's 802.11bgn Wi-Fi and Bluetooth 4.0 as well, but its quoted battery life of "up to four hours" doesn't inspire confidence.

Microsoft has revamped the Windows 10 interface for compact tablets, making the live tiles bigger and introducing a system-wide back button. Microsoft has also reduced the operating system's footprint, handing more storage space to apps and files.

The Windows Connect is available now for £99 from the Tesco website, or for as little as £49.50 if you have Clubcard vouchers to spare.

◆ The Tesco Windows Connect is the first tablet we've seen running Microsoft's new operating system

palicomp

www.palicomp.co.uk

Tel: 01270 898104

PRICE MATCH ANY SYSTEM

AMD Kaveri Evolution - KAVI

AMD Kaveri A10-7700K
O.C to 4Ghz
ASUS A88XM-PLUS
CRUCIAL 8GB 1600Mhz
SEAGATE SSHD 1TB SATA3
AMD Radeon R7 Graphics
ZALMAN Z3 Case
ASUS 24" HDMI LED

£499.99

AMD Nemesis Cube - NEMI

AMD Athlon X4 860K Black
O.C to 4.2Ghz
ASUS A88XM- PLUS FM2+
CRUCIAL 8GB 1600Mhz
SEAGATE 1TB SATA3 HDD
AMD R7 370 4GB
BITFENIX Prodigy M Case
ASUS 24" HDMI LED

£599.99

INTEL i5 Devil Blaster - HASO

INTEL Core i5 4690K
O.C to 4.4Ghz
ASUS Z97-P
CRUCIAL 8GB DDR3 1600Mhz
SEAGATE SSHD 1TB SATA3
AMD R7 370 2GB
ZALMAN Z3 Case
ASUS 24" HDMI LED

£699.99

intel Skylake Range
Now Available

INTEL i7 Elite - HAS11

INTEL Core i7 4790K
O.C to 4.7Ghz
ASUS Z97-PRO Gamer
Crucial 16GB DDR3 1600Mhz
Crucial 256GB SSD
SEAGATE 3TB SATA3
NVIDIA GTX980 4GB
CORSAIR 750W PSU
THERMALTAKE V51 Case

£1299.99

Q-Jump Service
Next Day Dispatch

Free Games on all
Gaming PC's

0% Apr Finance Available*

*Early settlement fee of £29.00 applies - see online

AWARD WINNING PC SYSTEMS



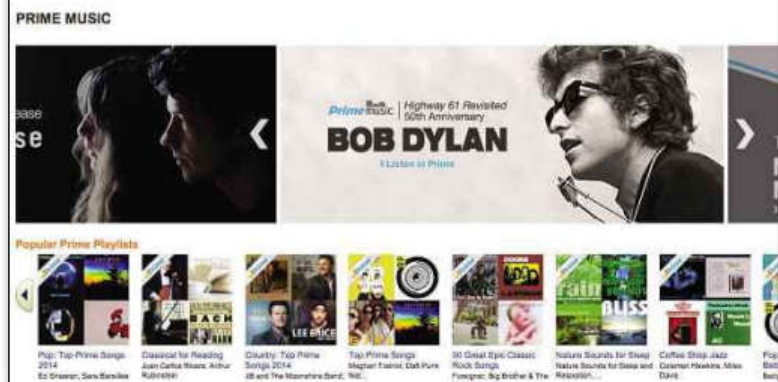
Amazon Prime Music arrives in the UK

AMAZON HAS LAUNCHED Prime Music in the UK. The new music-streaming service is another perk for Amazon Prime customers, which has been added at no extra cost to their £79-per-year subscription. Prime Music offers over a million songs to Prime customers and is ad-free, allowing you to enjoy all the latest hits without interruption.

You'll need to sign up to Amazon Prime to take advantage of Prime Music (or sign up for a free 30-day trial) but, once you do, you'll be able to listen to the service on a whole range of devices, including Amazon Fire tablets, Amazon Fire TV, the Fire TV Stick, iOS and Android devices, PCs, Macs and, of course, through the Amazon website.

Phone and tablet users will be able to download tracks for offline playback as well, so you can carry on listening even when you're not connected to the internet. Downloaded music will only be available within the Amazon Music app, though, so you won't be able to export those tracks to other devices.

Prime Music will also let you choose from hundreds of hand-built Prime Playlists, covering all manner of artists, genres, occasions,



↑ Amazon Prime Music is ad-free and has a library of over a million songs, but it's only available for Amazon Prime members

moods and activities – there's even a dedicated 'commuting' playlist designed for the morning train ride.

If you'd rather create your own playlist, you'll be able to mix Prime Music tracks with your own personal music collection. However, there are some noticeable gaps in the Prime library. Several artists from the Universal Music Group, including Amy Winehouse, Abba and Kanye West, weren't available at launch.

Prime Music is Amazon's answer to rival music-streaming services such as Spotify, Deezer and Apple Music, but it still has some way to go before it can compete with Apple's and Spotify's libraries of over 30 million tracks each.

Hackers target Carphone Warehouse

CARPHONE WAREHOUSE HAS apologised after admitting that 2.4 million customer records have been stolen from three of the company's websites. The stolen data includes bank and credit-card details.

The attack wasn't targeted at the main Carphone Warehouse website, but three of the company's subsidiary sites: *onestopphonestop.com* (now seemingly defunct), *www.e2save.com* and *www.mobiles.co.uk*. However, even Carphone group customers who haven't made purchases directly from any of those three sites may still be affected, with the company reporting that "these websites also provide a number of services related to mobile phone contracts to iD Mobile, TalkTalk mobile, Talk mobile and Carphone Warehouse".

The stolen data includes customers' names, addresses, dates of birth, bank and encrypted credit-card details. Carphone hasn't revealed details of how the credit card details were encrypted, making it hard to tell if that data is vulnerable.

Carphone says it has emailed "all customers we believe may have been affected", although customers should take particular care with emails that appear to come from the company. The thieves may use the stolen database to launch phishing attacks on customers, urging them to click on malicious links to reset their password, for instance.

Dixons Carphone chief Sebastian James says the company takes "the security of customer data extremely seriously, and we are very sorry that people have been affected by this attack on our systems".

The attack wasn't focused on Carphone Warehouse itself, but it affected many of its subsidiary companies, including its new network iD Mobile



4K Blu-ray launching in time for Christmas

4K BLU-RAY HAS been a long time coming, but the Blu-ray Disc Association (BDA) has finally started licensing the specification for Ultra HD Blu-ray. Licensing officially began on 24th August, paving the way for hardware and content manufacturers to start filling shop shelves with 4K Blu-ray discs and 4K Blu-ray players, hopefully just in time for Christmas this year.

Using the UHD resolution of 3,840x2,160, the UHD Blu-ray specification will hold 66GB on dual-layer discs and 100GB on triple-layer discs (current Blu-rays only hold 50GB). It will support High Dynamic Range (HDR), expanding the range of colours between the blackest blacks and whitest whites, and run up to 60fps.

It also has an optional 'digital bridge' feature, which theoretically allows customers to watch UHD content across a wide range of home and mobile devices. It's not yet clear how this will work, but it should hopefully put an end to buying the same film several times if you want to watch it on your tablet or phone.

More importantly, it will be backwards-compatible with existing Blu-ray discs, so you needn't worry about having to replace your entire film collection.

"Ultra HD Blu-ray enables the delivery of an unparalleled, consistent and repeatable experience that will set the standard for Ultra HD entertainment, the same way Blu-ray Disc did for high-definition viewing," said Victor Matsuda, chair of the BDA's Promotions Committee. "With the commencement of licensing we would anticipate product announcements from various companies as we approach the 2015 holiday season."



↑ Now the official specification for 4K Blu-ray is available, it shouldn't be long before we start seeing 4K Blu-ray discs on the shelves

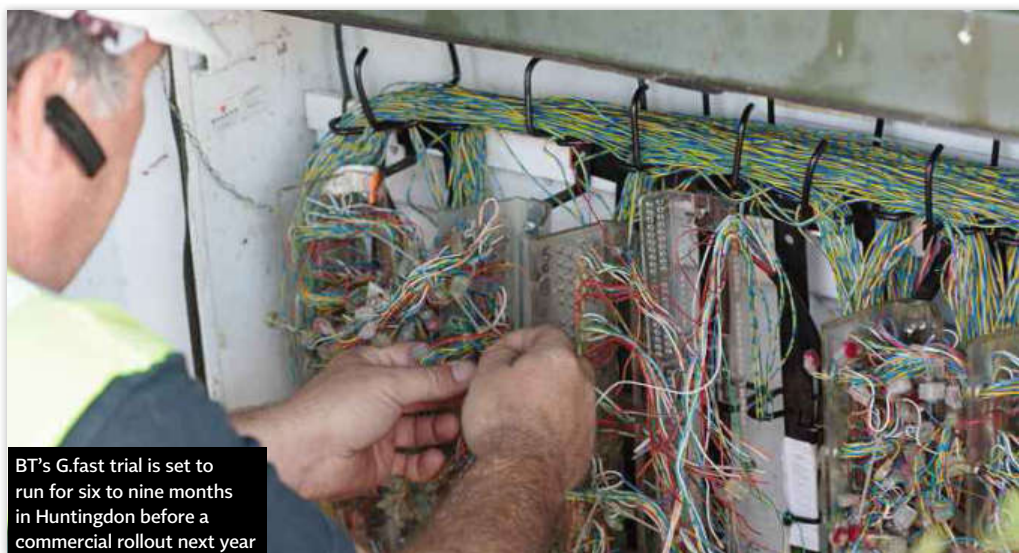
BT starts trials of 330Mbit/s G.fast fibre

BT HAS BEGUN a large-scale trial of a new fibre broadband technology that can boost download speeds to 330Mbit/s. The G.fast technology is being trialed in Huntingdon, and allows BT to squeeze even more capacity out of the copper telephone lines.

G.fast is essentially a halfway house between fibre-to-the-cabinet (FTTC), which currently delivers a maximum download speed of 80Mbit/s, and full-blown fibre-to-the-premises (FTTP), which is currently pegged at 330Mbit/s, but has the ability to deliver speeds of 1Gbit/s and beyond.

G.fast sees high-capacity fibre cable moved closer to the customer's home, although not right to the customer's door. Instead, the cable is run from the local fibre cabinet to a smaller piece of hardware (called a distribution node) that can be fitted to a telegraph pole or placed underground. The last stretch of the connection still runs over the speed-sapping copper, but because the length of copper wire is shortened, speeds are dramatically increased.

BT says it has already squeezed speeds of 330Mbit/s from G.fast lines and that the technology will "make speeds of a few



BT's G.fast trial is set to run for six to nine months in Huntingdon before a commercial rollout next year

hundred megabits per second available to millions of homes by 2020 and deliver up to 500Mbit/s to most of the UK within a decade". However, BT warned the technology will only be rolled out "if UK regulation continues to encourage investment".

Even if it does proceed with G.fast, BT will still lag behind Virgin Media, which is about to upgrade its network's top speed to 300Mbit/s. BT is at least a year away from a commercial rollout of G.fast, with the Huntingdon trial set to run for the next six to nine months.

Microsoft improves AV protection but Security Essentials still trails the pack

MICROSOFT'S SECURITY ESSENTIALS software, worked on by the same team that secures Windows 10, has made significant improvements in the last three months according to the latest security testing results from Dennis Technology Labs. DTL, which provides the data for *Computer Shopper's* anti-virus reviews and is owned by the same company, awarded Security Essentials an AA rating (the second highest ranking) for the first time.

Security Essentials still trails the pack in the Home AV rankings, but it got closer to its rivals than ever before in a hotly competitive round

Security Essentials still trails the pack in the Home AV rankings, but it got closer to its rivals than ever before

of testing for the second quarter of 2015, managing a Total Accuracy score of 90%, which is just 1% behind G-Data Internet Security and 4% behind the Intel-owned McAfee Internet Security.

Kaspersky Internet Security 2015 and Symantec's Norton Security were the only two software providers to score perfect 100% Total Accuracy scores while Avast! was once again the top-ranking free software with a 96% rating.

ESET Smart Security 8 scored well in third place, and was the only other piece of software that was able to protect against 100% of attacks. Its slightly lower overall score of 97% was caused by allowing 13 attacks to run before neutralising them, something both Kaspersky and Norton kept to a minimum.

AVG Anti-Virus Free scored one of its best results to date, managing an overall score of 95%, while Trend Micro maintained its consistent AAA rating with a score of 97%.

The tests subject Windows 7 PCs to the most prevalent sources of malware. Simon Edwards of Dennis Technology Labs, told *Shopper* that the high standard of this quarter's results was partially down to a shift in the types of malware attacks consumers are facing in 2015.

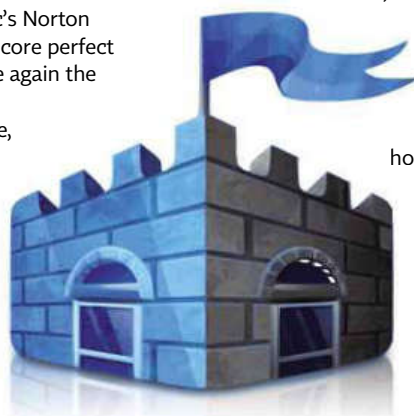
"In this period we saw a very large percentage of ransomware-based threats," he explained. He said Microsoft's strong result was down to improved definitions for CryptoLocker-style ransomware attacks, which is currently the most prevalent type of attack. "If a vendor such as Microsoft has really good coverage of that type of threat, you'd expect it to do very well in this test."

"Microsoft's result is a realistic representation of what's happening in the real world, where customers are facing massive amounts of ransomware and maybe some of the other campaigns, such as those that use fake AV, appear to be quieter at the moment."

Security Essentials is only available for Windows Vista and Windows 7 PCs and is typically touted as providing a base-level of defence.

Indeed, Microsoft's improved result, while comforting to those running no other anti-virus software, should not be used as justification for not installing additional malware protection. After all, it was completely compromised by 12 attacks during testing, something that would have a serious impact on any home or small business user.

◆ Microsoft Security Essentials still isn't good enough to be your only piece of anti-virus software, but it showed a marked improvement in the latest round of security testing



HTC Vive: Hands on with Oculus Rift's big rival

An unlikely collaboration between a phone manufacturer and a gaming giant has produced one of the most exciting virtual reality systems yet. We tried it out

VIRTUAL REALITY LOOKS set to be the next big thing in gaming, but the revolution has been a long time coming. It's also a revolution that lacks a coherent message, with a multitude of platforms all offering their own spin on the VR experience. Oculus Rift has been the darling of the PC gaming community since 2013 (although its acquisition by Facebook tarnished the love affair somewhat), and more recently we've had Sony's Morpheus PlayStation 4 headset, the smartphone-based Samsung Gear VR and Google's cheap-VR-for-all Cardboard viewer.

One of the most exciting VR headsets to appear comes from smartphone manufacturer HTC. The HTC Vive has the huge advantage of being produced in collaboration with gaming behemoth Valve (we were wondering what Valve was doing instead of making Half-Life 3), and we've finally had a chance to experience the new headset.

WHALE OF A TIME

Our first experience with the HTC Vive was nothing short of awe-inspiring. We were standing on the deck of a sunken ship, edging towards the prow to look down into the watery abyss below. Sensing, or maybe hearing, something over our left shoulder, we turned to find a huge whale had snuck up while we were distracted. We backed away in surprise, and then marvelled as this glorious leviathan glided past just out of reach, its huge eye tracking us as it went.

That illustrates one of the big selling points of the HTC Vive; it not only provides an immersive audio-visual experience, but also has a location-tracking system that allows it

➔ The headset is studded with sensors to help you immerse yourself in the virtual world



to track your physical movements and re-create them in the virtual world. What's more, it works brilliantly, with both moving and turning tracked with incredible accuracy; you can drop to your knees behind something, for example, and then peer out past it into the game world.

VIVE LA DIFFERENCE

The HTC Vive actually consists of three elements: the Vive headset, a pair of location-sensing base stations and a SteamVR control stick for each hand.

The headset is a typical strap-it-to-your-head VR model, similar in size and weight to the current Oculus. In terms of design, both headsets lag behind Sony's Morpheus, with its

clever ring that distributes the weight across your head and leaves the screen just touching your face, rather than pushed up against it.

Inside the headset is a pair of 1,080x1,200 OLED displays. You can see the pixel grid if you look hard enough, but you won't notice when you're immersed in the virtual world. These displays refresh 90 times a second, and so provide very smooth feedback in response to your motions. The headset has a 100° field of view, and everything looked crisp in the centre of our view, but lost sharpness when we glanced to the side instead of turning our head to look around. In this respect the Vive is much like other VR headsets.

FINDING YOUR PLACE

The location-sensing base stations look more pre-production than the headset: they're currently just small black cubes with an array of chips on the front. You place them in opposite corners of the room, creating a virtual space up to five metres square. Lasers in the stations are then tracked by the headset, which is studded with sensors, in order to calculate the user's exact position and the angle of their head.

Finally, there are the SteamVR controllers. These stick-like devices don't look like anything special, with a single trigger, a touchpad on the front – which is taken from Valve's Steam Controller design – and a strangely angular head, which again helps to locate the controllers in the world using laser positioning. However, the controllers will be



The only thing we didn't like about the Vive was occasionally getting snagged in the headset's cables

much more interesting in the virtual world, where they will transform into a variety of more interesting shapes and devices.

We started the controller demonstration in the white expanse of the initial calibration space. We tried asking for “guns, lots of guns”, but to no avail. What we could do was create balloons by pulling a trigger, which would then inflate from the top of the controller in our hand (or rather a virtual representation of the device in shining white). The balloons rose slowly, and we could then bat them away with the controller, whose motions in the virtual world matched our physical ones perfectly. The balloons flew off as expected; the only aspect the experience lacked was any tangible feedback as we bopped them.

CABLE NOT WIRELESS

After a few more engaging experiences, we were totally immersed in the Vive's virtual reality and had largely forgotten about the darkened room we were physically standing in, somewhere on the show floor of Gamescom in Cologne. The only snag, literally, was the cable protruding from the back of our head, which we got tangled up in a couple of times when stepping backwards.

This isn't a big problem when you're sitting down, but when you're moving about, which the system is designed to let you do, the cable can be an immersion-breaking liability. We'd like HTC to come up with a way to keep the cable out of the way; we're not sure wireless is feasible, as the headset needs to



Valve's Secret Shop is a great demonstration of how to draw you into a virtual world

carry lots of data from a heavyweight gaming PC to keep the 90Hz visuals running smoothly.

SECRET SHOP

The high point of the demo came at the end, when we were able to play around in Valve's Secret Shop demo. Although the other Vive demos were limited in scope, graphically simplistic or both, the Secret Shop is a luscious fantasy experience with nods to Valve's mind-bogglingly popular Dota 2 game.

The demo is set in a small, rickety hut rendered in the bold and colourful style familiar from Dota 2 (and most of Blizzard's fantasy titles, too, from Warcraft to Hearthstone). The Secret Shop starts out enveloped in darkness. Then the rotund shopkeeper arrives and provides a small magical light for you to wield. Using this light you can explore the shop (which in size roughly equates to the area of movement that the Vive allows) and shrink yourself down in size to get up close with its details.


We watched in horror as a tiny spider, rendered huge in our eyes, approached

over a desk. We explored a shelf and were startled by a huge toad, and finally the roof of the hut was ripped off by a dragon. It's very immersive stuff and beautifully rendered, with gorgeous, highly-detailed graphics that really show what virtual reality can do.

We wished we'd had another 10 minutes with the demo, but then again that further 10 minutes would have probably been enough. This lack of long-term appeal can apply to all our experiences with current-generation VR. There simply isn't enough content out there to persuade most people to part with their cash; it's all still very much early adopter stuff. However, there's so much interest in the technology, from major companies such as HBO, Lionsgate and Google, that we hope enough content will appear to persuade more mainstream consumers to buy into VR.

WILL IT SUR-VIVE?

So far, HTC and Valve's Vive virtual reality platform is looking very impressive indeed. The hardware is up there with the best currently available, and the motion tracking and controllers are brilliantly implemented. Surprisingly, the consumer version of the headset is set to launch this year; in a sector where 'coming next year' is the perennial mantra, the Vive's rapid move to a full launch has to be applauded. The question is whether there will be enough software to justify a purchase, or whether those interested in moving to VR should see what becomes of the Vive's rivals from Oculus and Sony.

We think that serious PC gamers will be the Vive's initial targets, as they already have the kind of super-powered PCs required to supply the headset with its pretty visuals. To date Oculus has grabbed the headlines, but after the Facebook acquisition, many such gamers would rather opt for a Valve-supported headset than throw their lot in with Mark 'Farmville' Zuckerberg. Who knows which VR headset will dominate the market, or whether there's room in gamers' hearts for several headsets to coexist and compete. On first impressions, though, the HTC Vive has as good a chance as any. 

The SteamVR controllers transform into all kinds of objects in the virtual world



The system can track whether you're crouching, standing, moving or turning for added virtual realism



REVIEWS

YOUR TRUSTED GUIDE TO WHAT'S NEW

LGA1151 PROCESSOR

INTEL

Core i5-6600K (Skylake)

COMPUTER SHOPPER ★★★★★

RECOMMENDED £209 inc VAT • From www.scan.co.uk

VERDICT

Modest CPU and GPU gains over the previous generation, but Skylake is as future-proof as it gets right now

INTEL'S TICK-TOCK processor development timeline took a bit of a tumble with Broadwell, at least on the desktop. While shrinking from Haswell's 22nm manufacturing process to 14nm mostly resulted in better power efficiency and extended battery life in laptops, performance gains on desktops were modest. Throw in the fact that the desktop chips were released very late and most PC builders and manufacturers didn't bother with it. Skylake is Intel's chance to make amends.

Skylake is a 'tock', an architectural redesign for improved performance and additional features, built on the same 14nm manufacturing process as Broadwell. This is partly why you won't be able to use Skylake processors in existing LGA1150 motherboards.

The Core i5-6600K looks like an excellent buy: it's faster than previous-generation Intel chips at stock speeds and beats AMD for graphics performance

Instead, the new 6th-generation CPUs use the new LGA1151 socket, meaning you'll need to buy a compatible motherboard to pair with it. Value-orientated H170 boards will be arriving later in the year, but high-end users, gamers and overclockers will be more at home with the premium Z170 chipset.

Indeed, the first two Skylake CPUs will be enthusiast-grade, fully unlocked chips designed specifically for Z170. The top-end Core i7-6700K has Hyper-Threading, meaning its four physical CPU cores appear as eight logical cores within Windows to give a boost to heavily multithreaded applications. The

Core i5-6600K doesn't use Hyper-Threading, but otherwise the two quad-core chips are very similar. The 3.5GHz i5-6600K has a maximum Turbo frequency of 3.9GHz out of the box, while the i7-6700K typically runs at 4GHz and Turbos to 4.2GHz. We looked at the

former for this review, as it will be the most sensible choice for most users, striking the best balance between value and performance.

CONTROLLER COASTER

Beyond mere clock speed increases, the biggest changes from the previous generation are under the lid. The on-chip memory controller now supports DDR4 memory, although it still retains a DDR3 controller, so motherboard manufacturers can make boards compatible with 1.35V DDR3L RAM if they choose. The fully integrated voltage regulator (FIVR) introduced with Haswell is gone,

meaning users now have complete control over voltages through the BIOS if their motherboard manufacturer allows it. The chipset also supports up to 10 USB3 ports and has more PCI-Express 3.0 lanes, which can be split multiple ways depending on whether you have multiple graphics cards. More exciting is the addition of U.2 support for NVMe storage, which promises to be significantly faster than the traditional SATA interface.

According to Intel, Skylake should provide around a 10% performance boost over a one-year-old PC running a 'Devil's Canyon' Haswell refresh-based processor, a 20% increase over a two-year-old Haswell-based PC and a 30% boost over an Ivy Bridge-based system. This sliding scale should be of interest to anyone still running a Sandy Bridge CPU; the i5-2500K has aged terrifically and can still hold its own today, but Skylake might finally be the chip to encourage you to upgrade.

Our 4K multimedia benchmarks largely validated Intel's claims, with an overall score of 113 outpacing the 100 achieved by our Core i5-3670K Haswell-based reference system.

AGAINST THE CLOCK

Intel was notoriously against overclocking in the past, keeping processors as locked down as possible. That has slowly changed over the





p28 | HP Pavilion Mini



p36 | Vodafone Smart Ultra 6



p51 | BT Ultra HD



p60 | Windows 10



p62 | Trine 3

past decade, however, with multiplier overclocking available on the enthusiast level K chips and ratio-based Base Clock (BCLK) overclocking introduced with Haswell in 2013. Skylake takes things even further, allowing complete control over the BCLK. As this clock is no longer tied to SATA and PCI-Express timings, you should be able to squeeze the absolute most out of each CPU without risking data or video corruption by sending SATA or PCI timings out of whack.

That being said, we weren't able to see many gains from pushing the Base Clock. Increasing it by even a few hertz led to instability and crashes until we started boosting the CPU voltage. We had more luck by increasing the multiplier, easily pushing the i5-6600K to 4.5GHz at maximum Turbo speeds without needing to adjust voltages.

This gave a significant boost in our multimedia benchmarks, producing a fantastic overall score of 146. We pushed the chip further to 4.7GHz for a slightly faster 148 total, but we had to increase voltages to beyond 1.35V to keep the chip stable. We'll need more time with Skylake in order to see how Base Clock settings can squeeze extra performance from the architecture.

A MAJOR DRAW

Overclocking dramatically increased power consumption, too: our reference system, fitted with an i5-6600K, two sticks of DDR4 RAM and an M.2 SSD, typically draws 29W at idle and 80W under load, but these figures jumped to 49W and 130W respectively after overclocking. Skylake might use the same 14nm process as Broadwell, but its out-of-box power requirements are considerably higher, too. Whereas desktop-based Broadwell chips have a 65W Thermal Design Power rating – the maximum amount of heat generated by the CPU that the cooling system has to dissipate – the i5-6600K has a 91W TDP.

Sadly, Intel didn't provide us with the new heatsink that will come bundled with all 6th-generation Core processors, so we used a third-party cooler, the Be Quiet! Dark Rock Pro 3. This monstrous two-fan tower cooler kept the i5-6600K at a very cool 28°C at idle.

Although we doubt many people would buy a multiplier unlocked processor and not pair it with a dedicated graphics card, the Core i5-6600K's onboard Intel HD Graphics 530 is significantly better than previous-

generation integrated GPUs. The Haswell-based i5-4670K could manage only 32.3fps in Dirt Showdown at 1,280x720 with 4x anti-aliasing and graphics quality set to High, but the i5-6600K managed 45.3fps. Importantly for Intel, this score outpaced AMD's A10-6800K, which produced 42.6fps. AMD has historically had faster integrated graphics, but this is a clear indication that Intel has caught up in terms of performance.

SHOULD YOU UPGRADE?

There's no doubt Skylake is a powerful platform, and although it isn't quite as power-efficient as the Broadwell architecture that came before, it will be arriving in much greater numbers and have much greater support from motherboard manufacturers. The Core i5-6600K in particular looks like an excellent buy, whether you plan on overclocking or not; it's faster than previous-generation Intel chips at stock speeds, beats AMD for graphics performance for the first time and uses a modern chipset that supports plenty of new and upcoming technologies such as U.2 and PCI-Express-based storage.

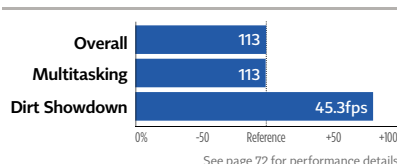
However, it will be an expensive upgrade. Not only do you have to consider the price of the processor, but also factor in the cost of a motherboard and, with all current boards, a set of DDR4 memory. Thankfully the latter is no longer quite as expensive as it was last year, but it's still nowhere near as simple as dropping a new chip into your existing system and flashing a BIOS update.

Haswell owners will only see modest gains in performance for an expensive initial outlay, but if you've been holding off upgrading for some time, Skylake is the perfect opportunity to overhaul your PC.

Tom Morgan

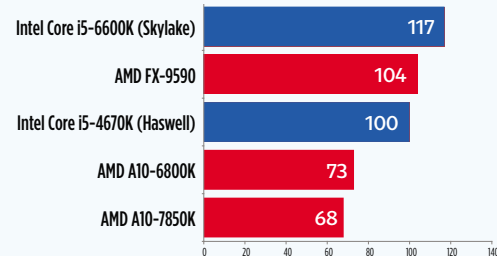
SPECIFICATIONS

SOCKET LGA1151 • CORES 4 • FREQUENCY (BOOST) 3.5GHz (3.9GHz) • INTEGRATED GRAPHICS Intel HD Graphics 530 • WARRANTY Three years RTB • DETAILS www.intel.com • PART CODE BX80662156600K



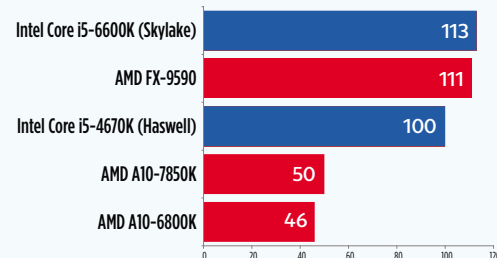
4K Multimedia Benchmarks

Image editing



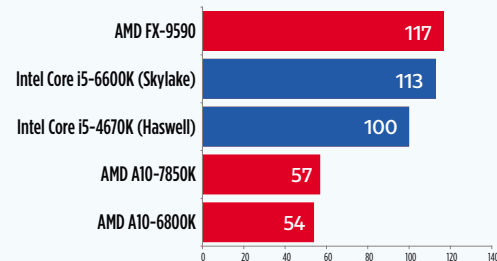
Skylake is clearly ahead in terms of single-core performance, thanks to its new architecture

Multitasking



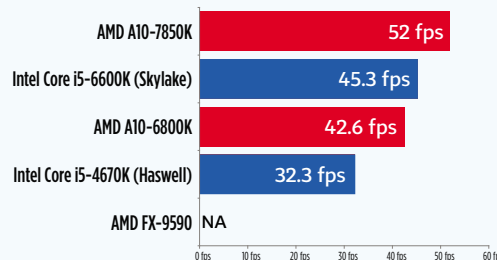
AMD's 8-core FX-9590 runs at a higher frequency, but still can't complete with Skylake's multicore performance

Overall



Skylake is an incredible performer given its power draw; AMD needs more cores and faster clock speeds to match it

Dirt Showdown (720p, 4x AA, High quality)



Intel has greatly improved its integrated graphics with Skylake, but this is one area where AMD's APUs still excel

SCAN 3XS Z170 Performance GTK5

COMPUTER
SHOPPER
BEST BUY£1,000 inc VAT • From www.scan.co.uk/3xs

VERDICT

A gaming PC with lots of room for expansion, great performance and a generous warranty

INTEL'S SKYLAKE PROCESSORS are hot off the press; as you'll see from page 24 they're a worthy, if slightly expensive, upgrade, requiring a new motherboard and DDR4 memory. If you're looking to start again with a fresh PC, though, the new processors couldn't have come at a better time. Scan's £1,000 3XS Z170 Performance GTK5 has everything you need to get started with Skylake.

The quad-core Core i5-6600K processor has a lot of overclocking potential; it runs at a 3.5GHz base clock speed and Turbo Boosts to 3.9GHz when thermal conditions allow, but you're doing the multiplier-unlocked chip a disservice if you don't overclock it. Scan has duly done so, installing a BeQuiet! Pure Rock air cooler and turning up the Turbo Boost speed to a huge, but stable, 4.6GHz. Even taxed to the max, the cooler remains extremely quiet. The processor is backed up by 8GB of 2,666MHz DDR4 RAM.

Scan's overclocking efforts set a new Labs record for a Core i5-powered desktop PC, with an overall score of 145. For comparison, the £1,129, 4.4GHz Core i7-powered Chillblast Fusion Raptor scored 151 overall. The i7-4790K has Hyper-Threading, which gives it a boost in multi-threaded tasks, hence the higher score.

STRONG SILENT TYPE

The 3XS Z170 Performance GTK5 isn't underserved in the graphics department, either, with an overclocked EVGA GeForce GTX 970 boosted from 1,050MHz to 1,190MHz. Despite the overclock, the fans don't even spin up until the GPU reaches 60°C, meaning it's completely silent on the Windows desktop. Even when the action picks up it's never overwhelmingly loud.

Our gaming benchmarks were unsurprisingly no challenge for the GTX 970, which managed an average 131.6fps in Dirt

Showdown and 50.3fps in Metro: Last Light Redux. Ramping up the resolution to 2,560x1,440 proved to be more of a challenge in Metro, but we were still able to reach 55fps at Very High settings by disabling HSAA. 4K resolution gaming at the highest settings proved too much, but if you have a 3,840x2,160 monitor, dropping graphics settings will get a playable frame rate. In Full HD, at least, you can expect to be playing the latest games at High settings for years to come.

PLAIN SPEAKING

We were a little disappointed with the Corsair Carbide 100R chassis. It's a little too plain for our tastes, and while a little bit of design flair would have gone a long way, you can always swap out the case for an alternative when configuring your machine on Scan's website. The case keeps noise well insulated, though, preventing the slight whine of the power supply and the cooling fans from becoming a distraction. The window on the left of the case lets you look in on the excellent cable routing; you won't find any wires floating across the case obstructing airflow here.

The Asus Z170-K motherboard has a huge amount of room for expansion, including a second free PCI-E x16 slot for another graphics card, two legacy PCI slots and a PCI-E x1 slot for smaller peripherals. There are two free DDR4 RAM slots if you want to double your memory in the future. Elsewhere, there are three free SATA3 connectors for extra storage, with two 2½/3½in drive bays free inside the case, although Scan has used the ports that double as SATA Express, so you'll need to swap the cables to install a SATA Express storage drive. There's also an M.2 slot for high-speed SATA or PCI-E-based SSDs.

The supplied storage is generous, however: you get a speedy 256GB Samsung 850 Evo SSD, which is more than enough for Windows and your games, while a 1TB Seagate Barracuda hard disk handles your other large files.

At the rear of the motherboard there are some fairly unusual ports, including two USB 3.1 ports and a USB Type-C connector. There aren't many peripherals that currently support the 10Gbit/s speeds of 'SuperSpeed' USB, but this is a futureproof motherboard that makes total sense if you're going to keep your PC for several years. There are two standard USB ports here, too, with a



further four USB3 ports at the front of the case. Two of those USB3 ports are part of the 3XS-branded (including a multi-coloured lit-up 3XS logo) Akasa card reader unit that sits in one of the 5¼ in drive slots at the front of the chassis, above the DVD drive.

COVER DRIVE

Scan's generous three-year warranty includes one year of on-site coverage including parts, and a further two years of RTB cover, again including parts. If you want to upgrade your PC and it's still under warranty, Scan will also cover labour costs for upgrading your machine; you just pay for the parts.

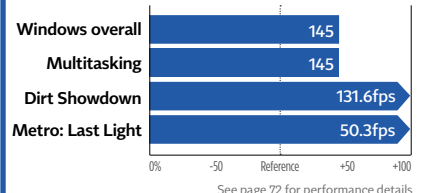
The Scan 3XS Z170 Performance GTK5 is a powerful desktop PC with impressive processing and graphics performance for £1,000. When you're spending this much, futureproofing is important, and with USB 3.1, plenty of expansion slots and graphics performance that will handle the latest games for years to come, this is one of the best PCs you can get for the money.

Michael Passingham




SPECIFICATIONS

PROCESSOR Quad-core 4.6GHz Intel Core i5-6600K (overclocked) • **RAM** 8GB • **FRONT USB PORTS** 4x USB3 • **REAR USB PORTS** 2x USB 3.1, 1x USB Type-C, 2x USB • **TOTAL STORAGE** 256GB SSD, 1TB hard disk • **GRAPHICS CARD** 4GB Nvidia GeForce GTX 970 • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 • **WARRANTY** Three years parts cover: first year on-site, years two and three RTB • **DETAILS** www.scan.co.uk/3xs • **PART CODE** Performance Z170 GTK5






Make It Yours.



**MAKE OF IT
WHAT YOU WILL**



MasterCase5

WITH FREEFORM™ MODULAR SYSTEM

Breaking new ground in case technology, the **MasterCase 5** by Cooler Master provides you the tools to make something special. Achieve absolute control over how your case looks and functions through our patented **FreeForm™ Modular System**. The exterior structure and internal layout can be customized, adjusted, and upgraded to meet your needs in pursuit of the maker spirit.

Go ahead, dive in, and explore. What will you make of it?

Learn more: [Coolermaster.com/MasterCase5](https://www.coolermaster.com/MasterCase5)

MINI-PC

HP Pavilion Mini



£349 inc VAT • From store.hp.com/uk

VERDICT

A classy mini-PC with room for expansion, but very strong rivals means its appeal is limited

HP'S PAVILION MINI is the latest in a slew of small form-factor PCs we've seen recently, with manufacturers gradually turning their attentions away from boxy, boring base units in favour of alternative designs and clever cases to tempt people to invest in a new PC.

The Pavilion Mini wouldn't look out of place on even the tidiest of desks thanks to its tiny footprint, curved corners, tapering edges and metallic design. This classy look is beaten only by the more expensive Mac Mini.

Inside, you get an upgradable 1TB 2½in hard disk, 4GB of RAM and a dual-core, 1.9GHz Intel Core i3-4025U processor. A laptop-level spec, then, so you should expect laptop levels of performance.

Indeed, in our dual-core benchmarks, which pits lower-end processors against a

of media-heavy web pages. You'll probably notice stutter when loading lots of photos at the same time, but if you moderate your usage and don't expect the world, the Pavilion Mini will serve you well.

LITTLE TINKER

If you like to tinker as much as we do, you'll soon find yourself burrowing beneath the rubber feet on the bottom of the device, hunting for screws to loosen. Inside, you'll find a compact build with a fair amount of room for expansion. Your first port of call will be the 1TB 2½in Samsung hard disk, which has been mounted to a caddy that is in turn attached to the chassis with four screws. The hard disk is connected to the board with what appears to

The free M.2 slot means you could install a small 42mm M.2 SSD for snappy performance, while keeping the capacity of a mechanical hard disk

reference Core i3-4030U that scores 100, the Pavilion Mini managed an overall score of 95. We were slightly surprised to see the PC manage just 81 in the short photo-rendering portion of the benchmark, but it picked itself up when converting video and multitasking, managing scores of 101 and 95 respectively.

The chassis never became uncomfortably hot at any point during our testing. The fan stuck to moderate speeds, only picking up to audible levels when tasked with our toughest benchmarks. You'll hear it in a quiet room, but its whirring will be drowned out entirely anywhere with ambient noise.

Actual day-to-day performance is fine; you'll notice a little slowdown if you're trying to do multiple things at once, or opening lots

be a proprietary SATA connector. There's a standard SATA connector at the other end, though, so if you want to upgrade to an SSD or a higher-capacity disk, you can.

Only one of the two RAM slots beneath the hard disk caddy is occupied with a 4GB stick of SODIMM memory, meaning there's room to upgrade later. Perhaps most interesting is the free M.2 slot; you could install a small 42mm M.2 SSD for snappy performance, while keeping the capacity of a mechanical hard disk. Be warned that any modifications you make will void your warranty, but at least you'll have fun doing it.

The Pavilion Mini has a decent selection of ports for such a tiny device, including two USB3 ports on the front and two more at the



rear. There's a Gigabit Ethernet port, a full-size HDMI output and a DisplayPort connector, making it well-suited to modern displays. There's also an SDXC memory card reader and a 3.5mm audio jack, which is awkwardly mounted at the rear instead of the front, so plugging in headphones on a regular basis will be fiddly. You also get 802.11n dual-band Wi-Fi, but there's no support for the faster 802.11ac.

TOUGH COMPETITION

Up against its mini-PC rivals, the benefits of the Pavilion Mini are slightly less clear. The Core i3 version of the Acer Revo One RL85 we reviewed in *Shopper 330* has room for two extra 2½in hard disks, although it has only a measly 500GB hard disk and two USB3 ports out of the box. The Mac Mini, meanwhile, starts with a 14GHz Core i5 chip, 500GB of storage and Intel Iris graphics, but costs £50 more. It's unclear where the Pavilion Mini fits in: it's a stylish device that would look good on any desk, but the same can be said of the Mac Mini. It could work as a media centre PC, but the Acer Revo One RL85 is arguably better at that, too, with its bundled a remote control.

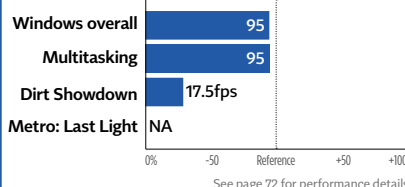
The HP Pavilion Mini, then, is a fine mini-PC with room for tweaks and upgrades that will serve modest users well, but it lacks the clear selling point that would earn it a Recommended award. If it came with a keyboard and mouse it would clearly find its niche as an office PC, but without any bundled peripherals it's left a little bit out in the cold.

Michael Passingham



SPECIFICATIONS

PROCESSOR Intel Core i3-4025U • **RAM** 4GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 2x USB3 • **TOTAL STORAGE** 1TB hard disk • **GRAPHICS CARD** Intel HD Graphics 4400 • **DISPLAY** None • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** One year collect and return • **DETAILS** store.hp.com • **PART CODE** 300-030na



INTEL Compute Stick STCK1A32WFC



£130 inc VAT • From www.dabs.com

VERDICT

A small, relatively cheap but seriously limited micro PC

WE LOVE MICRO PCs. Having a proper Windows computer in a box as big as a pack of chocolates that would spoil an ambassador is a fantastic and cheap alternative to an all-in-one PC for those short of space. The latest fad takes advantage of the small size and low power requirements of Intel's Atom processors, making PCs not much bigger than a Wi-Fi dongle. This is an impressive feat of engineering, but as we found in our Hannspree Micro PC review (tinyurl.com/333micro), the resulting PC is so frustratingly limited that we're not sure we see the point.

The Compute Stick is Intel's own micro PC design, and is almost identical to the Hannspree model. You get the same compact chassis with an HDMI plug on the end, the same quad-core 'Bay Trail' Intel Atom Z3735F system-on-chip and the same 2GB RAM and 32GB storage. The stick takes power from a Micro USB connector, but you'll need a 2A power supply; the 0.5A USB socket on the back of our TV couldn't get the Compute Stick to boot. The model we reviewed runs Windows 8.1 with Bing, but an Ubuntu version is also available for £90. That edition only has 8GB storage, though, so would work best if you keep most of your files in the cloud.

VINTAGE PORT

The limitations of such a small PC are evident as soon as you set it up. The single USB port is one of the bigger problems, as without Bluetooth peripherals you'll need a wireless keyboard and mouse set with a single receiver if you want to use both at the same time. Even then, Windows' Bluetooth support has always been poor, and we experienced plenty of disconnections with our Bluetooth keyboard – which is hard to rectify when you don't have any input devices plugged in. With a USB dongle in place, there's nowhere to plug in a card reader or USB drive, so getting files on and off the Compute Stick could be tricky.

This is an old-fashioned way of looking at things, of course: you could just use Dropbox

or OneDrive for your file transfers, and upload photos straight from your smartphone or Wi-Fi-enabled camera. However, this is somewhat stymied by the Compute Stick's 802.11n chipset, which only supports the 2.4GHz band. This limits where you can use the Compute Stick; at around 10m from our wireless router, Speedtest.net showed downloads crawling at less than 0.1Mbit/s. By contrast, a Tesco Hudl 2 in the same room could max out our 38Mbit/s fibre broadband connection thanks to its 5GHz 802.11n support. You'll have to move the Compute Stick near your router to have any kind of usable network speed.

The single USB port means this is a tricky situation to rectify, as you can't even plug in a

All this left us wondering what we could use the Compute Stick for. It's a reasonable web-browsing and email/word-processing device (if you have a Wi-Fi printer), but for a basic Windows machine we'd rather find a bit more cash and build it ourselves, complete with enough USB ports to plug things in. It's not even a Chromecast substitute, as the Compute Stick can't play HD films from the Google Play store on your TV.

MEDIA SAVVY

One use does stand out, however: you could use the Compute Stick as a UPnP media server and renderer. With a high-capacity microSD card for your music, a media server such as Serviio and using the Foobar2000

The single USB port means you can't even plug in a USB Wi-Fi dongle to boost network speeds

USB Wi-Fi dongle. If you want to add USB ports there's always the option of a hub, but you'll need a powered model; we tried a passive hub and it couldn't even power a wireless keyboard adaptor and a USB flash drive at the same time. You can also use Intel's Remote Keyboard app on your smartphone or tablet in conjunction with a server on the Compute Stick, which works reasonably well for some light web browsing.

The quad-core 1.33GHz Intel Atom Z3735F processor isn't very powerful. It scored just 9 overall in our benchmarks, hindered by a particularly poor score of 2 in the multitasking benchmark. This was still half the time of Hannspree's, however.

The Compute Stick copes well with most tasks, such as web browsing or playing Full HD video, but try opening a web page in one tab while another is still rendering and everything grinds to a halt. It also takes forever to install updates on shutdown; at one point it took 30 minutes to install nine updates, which is tricky for a portable device you're mean to take with you; Windows doesn't take kindly to being interrupted mid-update.

music player with the UPnP plug-in, we could play music through our TV via the Compute Stick, controlling which tracks were played from an Android tablet running BubbleUPnP. However, you could also use a £30 Raspberry Pi running OpenELEC for the same purpose.

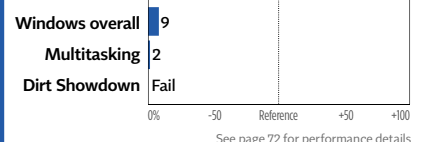
It may be tiny and relatively cheap, but the Compute Stick is seriously limited. It has its niche uses, but if you're after a properly useful tiny PC you're better off saving up for something more capable, such as an MSI Cubi.

Chris Finnamore



SPECIFICATIONS

PROCESSOR Quad-core 1.33GHz Intel Atom Z3735F • **RAM** 2GB • **FRONT USB PORTS** 0 • **REAR USB PORTS** 1x USB • **TOTAL STORAGE** 32GB • **GRAPHICS CARD** Intel HD Graphics • **DISPLAY** None • **OPERATING SYSTEM** Windows 8.1 with Bing • **WARRANTY** One year RTB • **DETAILS** www.intel.com • **PART CODE** BOXSTCK1A32WFCR



GAMING LAPTOP

MSI GE62 2QE Apache

COMPUTER
SHOPPER

★★★★★

BEST BUY

£910 inc VAT • From www.laptopsdirect.co.uk

VERDICT

The MSI GE62 2QE Apache is a powerful laptop with a great screen, keyboard and price

MSI'S LAPTOPS HAVE always focused on gaming, and in recent years have struck a great balance between price and performance. They've never been pretty, though, preferring to let companies such as Alienware put a premium on unique designs. The GE62 2QE Apache largely sticks to the same formula.

It's not a bad thing that design and build quality don't venture far from the tried and tested, but the black aluminium finish, red go-faster stripe and crimped lid don't have quite the same appeal they once did. It's not particularly thin or light, but we don't imagine this being a big priority for gamers who care more about frame rates than portability; 2.4kg is roughly what we'd expect from a gaming laptop at this price and specification.

There's plenty of room for ports, and MSI has filled every last centimetre. There's a DVD optical drive, USB port and SD card reader on the right, and three USB3 ports, two 3.5mm audio jacks, Gigabit Ethernet, DisplayPort and HDMI video outputs on the left. You also get 802.11ac Wi-Fi and Bluetooth 4.0.

WHEELS OF STEEL

The SteelSeries-branded backlit keyboard has just the right amount of travel. Backlighting can be customised using the pre-installed SteelSeries Engine software, letting you change the colour and intensity of three separate zones. Gamers can also assign macros, but with no dedicated keys you'll need to sacrifice other keys or use combination commands to use them effectively. The half-height Return key isn't ideal, either.

The touchpad has the same brushed aluminium texture as the surrounding wrist rest, which makes it uncomfortable to use. The Synaptics drivers are poor, making two-fingered gestures such as scrolling laggy and unresponsive, but you can disable the touchpad with a keyboard shortcut. Gamers will use a mouse most of the time anyway.

The capacious chassis leaves room for powerful components, including a quad-core Intel Core i7-4720HQ processor clocked to 2.6GHz, 8GB of 1,600MHz RAM, an Nvidia GeForce GTX 965M graphics chip and 128GB of M.2 flash storage for speedy file performance.

128GB isn't a huge amount of space, so you'll have to carefully manage the files you store on each drive. There's room inside for three M.2 SSDs, although this model uses just one, paired with a traditional 7,200rpm 1TB mechanical hard disk for bigger files. More expensive configurations can use three M.2 SSDs in RAID 2 for a capacity of up to 768GB, although this will see costs shooting up very quickly indeed. We measured performance in the AS SSD benchmark at 493MB/s for reading sequential files and 217MB/s for write speeds, which is speedy enough.

FEEL THE HEAT

The processor has a whopping 47W thermal design power (TDP), meaning things get pretty heated when it's under load. Even with two fans, the cooling system has its work cut out when the processor is pushed hard, and it makes a fair racket as it ejects hot air through the rear vents.

The heat and noise is acceptable, though, as performance is impressive, with scores that compare favourably with Core i5-powered desktop PCs. Single-core performance in our image-rendering test was excellent, with a score of 105 translating to responsive desktop application use and gaming performance. Video rendering was nearly as good, with a score of 93, while multitasking took a bit of a hit: playing Ultra HD video while converting video and images yielded a much lower, albeit still impressive, 73, for an overall score of 85.



The GTX 965M is paired with 2GB of GDDR5 RAM, and is very capable indeed, managing performance comparable to desktop GeForce GTX 750 Ti graphics cards. It managed a smooth 51.4fps in the Full HD Dirt Showdown benchmark, 20.1fps in Metro: Last Light Redux with SSAA switched on and a much more playable 39.6fps with SSAA turned off.

PANEL GAMES

The Samsung PLS panel really lifts the Apache above its rivals. With 92.7% coverage of the sRGB colour gamut, a big 911:1 contrast ratio and reasonably low 0.4cd/m² black levels, images look rich and colourful. Viewing angles are wide, too. We were able to see plenty of detail when navigating through the dank subways of Metro: Last Light Redux. It's also very bright at over 360cd/m², which, combined with the anti-glare coating, means you should be able to game outside (although not in direct sunlight) if the mood takes you.

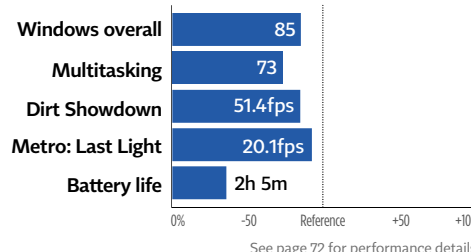
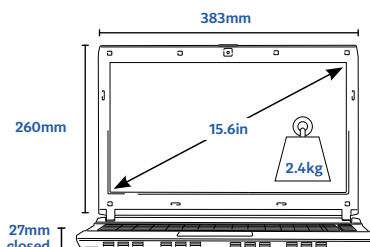
Battery life in our moderate-usage test was just two hours, which is below average even for a high-power gaming laptop. Expect even less time unplugged when playing games.

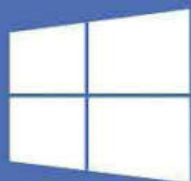
The GE62 2QE Apache is a well-specified gaming laptop with a great screen and price. It costs less than Scan's excellent 3XS Graphite LG157 yet has a faster processor and graphics chip. With an excellent screen and keyboard, the Apache is a capable machine that will be able to play the latest games in Full HD resolution for years to come and, despite the short battery life and skinny SSD, earns its place as our favourite gaming laptop.

Michael Passingham

SPECIFICATIONS

PROCESSOR Quad-core 2.6GHz Intel Core i7-4720HQ • **RAM** 8GB • **DIMENSIONS** 383x260x27mm • **WEIGHT** 2.4kg • **SCREEN SIZE** 15.6in • **SCREEN** RESOLUTION 1,920x1,080 • **GRAPHICS** ADAPTOR Nvidia GeForce GTX 965M • **TOTAL STORAGE** 128GB SSD, 1TB hard disk • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** Two years RTB • **DETAILS** www.msi.com • **PART CODE** 9S7-16J112-020





Windows 10

Available Now

- The fastest Windows ever
- The ultimate gaming platform with Direct X 12
- Familiar yet expanded Start menu
- Beautiful, elegant UI for desktops and laptops

FUSION MASTER

Cooler Master MasterCase V Case
Intel® Core™ i7-6700K Skylake Processor
Cooler Master Nepton 240M Cooler
Asus Z170 PRO GAMER Motherboard
NVIDIA GeForce GTX 980 4GB
16GB 3000MHz DDR4 Memory
512GB Samsung M.2 PCIe SSD
2000GB Seagate SSHD Hybrid Drive
Cooler Master VS Series V 750W Power Supply
Onboard High Definition Audio
Windows 10 64bit OEM

From **£1699** inc VAT



Windows 10 and SKYLAKE are here!



FUSION CENTURION

Zalman Z3 Case in Black
Intel® Core™ i5-6600K Skylake Processor
Akasa Nero 3 CPU Cooler
Asus Z170-K Motherboard
NVIDIA GeForce GTX 750 1GB
8GB 2133MHz DDR4 Memory
128GB Samsung M.2 PCIe SSD
1000GB Hard Disk Drive
Aerocool 600W Power Supply
Onboard High Definition Audio
Windows 10 64bit OEM

From **£649** inc VAT



FUSION NEO

Zalman Z11 Neo Case
Intel® Core™ i5-6600K Skylake Processor
Corsair H55 Liquid Cooler
Asus Z170-K Motherboard
NVIDIA GeForce GTX 960 2GB
16GB 2133MHz DDR4 Memory
128GB Samsung M.2 PCIe SSD
1000GB Seagate SSHD Hybrid Drive
Aerocool 600W Power Supply
Onboard High Definition Audio
Windows 10 64bit OEM

From **£999** inc VAT



FUSION CORE

Thermaltake Core V51 Case
Intel® Core™ i5-6600K Skylake Processor
Corsair H55 Liquid Cooler
Asus Z170 PRO GAMER Motherboard
NVIDIA GeForce GTX 970 4GB
16GB 2133MHz DDR4 Memory
256GB Samsung M.2 PCIe SSD
2000GB SSHD Hybrid Drive
Aerocool 700W Power Supply
Onboard High Definition Audio
Windows 10 64bit OEM

From **£1299** inc VAT



FUSION EMISSARY

Fractal Design Define S Case
Intel® Core™ i5-6600K Skylake Processor
Fractal Design Kelvin S36 Liquid Cooler
Asus Z170 PRO GAMER Motherboard
ASUS STRIX GeForce GTX 960 4GB
16GB 2133MHz DDR4 Memory
120GB Samsung M.2 PCIe SSD
1000GB Seagate SSHD Hybrid Drive
Corsair RM 750 Semi Active Power Supply
Onboard High Definition Audio
Windows 10 64bit OEM

From **£1199** inc VAT

FINANCE AVAILABLE ON ALL SYSTEMS OVER £250*
Terms & Conditions apply. Credit subject to status and affordability.

£15 OFF ANY CHILLBLAST PC
WITH THE CODE
COMPSHOP0915

The UK's most awarded PC Builder**

But don't just take our word for it...

-Five time winner of PC Pro Excellence Award!

-Four time winner of PC Advisor Best Desktop Brand!

-Builder of the World's Fastest PC!***

-Computer Shopper & Expert Reviews Best PC Manufacturer 2012



* Credit subject to status and affordability. Credit is provided by a panel of lenders with whom we have a commercial relationship - we are not able to provide independent advice. Terms & Conditions apply. Credit subject to status and affordability.

** Chillblast won more awards in the leading IT press publications PC Pro, PC Advisor and Computer Shopper combined than any other retailer 2010-2013

*** World's fastest PC as tested by PC Pro Magazine <http://www.pcpro.co.uk/reviews/desktops/371152/chillblast-fusion-photo-oc-iv>
Intel, the Intel Logo, Intel Inside, Intel Core, Core Inside, Pentium, and Pentium Inside are trademarks of Intel Corporation in the U.S. and/or other countries.

Terms and conditions are on the website. All trademarks are acknowledged. Pictures are for illustration only.
Prices are correct at time of going to press (28-08-15) E&OE



CHILLBLAST DEFIANT 2 MINI 13"

Intel Core i7 4710MQ Processor
13.3" (1920x1080 Resolution) IPS Display
8GB DDR3 at 1600MHz System Memory
NVIDIA GeForce GTX 860M 2GB GDDR5
1000GB Hybrid SSD/HDD
802.11N Wireless
2M HD video camera
Windows 7 HP 64bit or Windows 8.1 64bit
330 (W) x 227 (D) x 31.9 (H) mm
2.1kg including battery

£899 inc VAT



FUSION BULLDOZER

Sharkoon Bulldozer Red Case
Intel Core i5 4670K OC to up to 4.2GHz
Corsair H60 Water Cooler
Gigabyte Z97X-SLI Motherboard
GeForce GTX 770 2GB Graphics Card
8GB PC3-12800 DDR3 Memory
1000GB SSHD Hybrid 7200rpm Hard Disk
Corsair 600watt PSU
Onboard High Definition Audio
Windows 7 HP 64bit or Windows 8.1 64bit

£849 inc VAT

5 YEAR WARRANTY
WITH
2 YEARS COLLECT AND RETURN
WITH ALL PURCHASES

Terms and conditions are on the website.
All trademarks are acknowledged.

Pictures are for illustration only.

Prices are correct at time of going to press (29-05-14) E&OE

BUDGET 4G TABLET

EE Harrier Tab



£200 inc VAT • From shop.ee.co.uk

VERDICT

A decent 4G tablet with good battery life and generous data plans, but mediocre performance fails to make it stand out

IF TWO NEW smartphones weren't enough, EE has now added a tablet to its array of Harrier products. The Harrier Tab is a 4G tablet that borrows the brushed metal finish and yellow camera accent from the Harrier smartphone. It's available on a range of pay-monthly data contracts, or for £200 on pay-as-you-go, making it an affordable way to watch films and stream music on the move.

A 4G tablet isn't necessarily the best way to get online if your phone contract has a generous data allowance, as you can simply tether both devices together, but there's no question built-in 4G is a convenience. EE's pay-monthly deals will likely give you far more data than any available phone contract too. For £18 a month with £30 up front, you can get a huge 10GB of data a month. This equates to £462 over the course of two years, so more budget-conscious users might want to stick to PAYG and top up when they need the data. That means paying £200 up front with an initial £10 top-up for 2GB of data over 30 days, or £215 up front with a £10 top-up for 6GB over 90 days.

This sounds a hefty investment, but the Harrier Tab has an impressive specification to justify the price. The 8in slate has a 16:9, 1,920x1,080 resolution display, giving it a pixel density of 275ppi. This is a fraction higher than the Tesco Hudl 2, ensuring that Android 5.1 looks very sharp.

GOING GREEN

Unfortunately, image quality is disappointing, with the screen displaying only 74.4% of the sRGB colour gamut. Blue, magenta and red coverage was extremely lacking, leading to slightly green-looking whites. Colours aren't punchy, but at least a high 472cd/m² peak brightness makes the Harrier Tab more practical to use outdoors or in bright lighting conditions. A contrast ratio of 1,185:1 is also good.

Qualcomm's 1.5GHz, octa-core Snapdragon 615 processor and 2GB of RAM make the Harrier Tab an effective multitasker. It scored 2,474 in the Geekbench 3 multicore test, putting it roughly 400 points behind the Nexus 9. A less impressive single core score of 657 puts it behind the Tesco Hudl 2, and a Peacekeeper web-browsing score of 744 isn't great, either. We saw a small amount of judder when loading media-heavy websites, but scrolling up and down the screen was otherwise responsive. We had few complaints in day-to-day use as well. The Harrier Tab was able to run Android 5.1 smoothly as we dipped in and out of the app tray.

While 364 frames in the GFXBench GL Manhattan test equates to only around 5.6fps, we were able to run simpler 2D games such as Threes and Alphabear with no problems. Hearthstone ran smoothly for the most part too. 10GB of the 16GB internal storage is available for games and apps, but this can be expanded with a microSD card.

We managed 10 hours of video playback with the screen brightness set to 170cd/m². This is over three hours longer than the Tesco Hudl 2 and an hour more than the Vodafone Tab Prime 6.

CLEAN CUT

Much like EE's Harrier smartphones, the Harrier Tab runs the vanilla version of Android 5.1. Apart from a few pre-installed apps, the Harrier Tab has a surprisingly clean interface for an own-brand device, as everything you need as an EE customer is contained in the My EE app. Here you can check your remaining data allowance, pay your bill, buy add-ons and access the EE Store.

The 8-megapixel camera on the rear is the Harrier Tab's biggest flaw. All our test images came out blue, with dingy colours and overexposed skies. Switching to HDR mode helped brighten up each photo, but each one was still spoiled by a noticeable blue sheen, so we wouldn't recommend using the camera unless you don't have any other camera-equipped gadgets to hand.

The EE Harrier Tab is a sensibly priced 4G tablet with great battery life and some tempting data deals for EE customers, but unless you're a heavy-duty streamer, there's little here to make it stand out. Screen quality and performance are both outshone by cheaper tablets such as the Tesco Hudl 2 and Acer Iconia One 8, and PAYG customers don't get a particularly good deal either,

with a measly 2GB of data costing £10 per month. Moreover, with the infinitely superior Nexus 9 now available for £200, the EE Harrier Tab just doesn't measure up to the competition. We think you'd be better off buying a Wi-Fi-only tablet and using your phone as a portable hotspot rather than shelling out for EE's data contracts.

Katharine Byrne



SPECIFICATIONS

PROCESSOR Octa-core 1.5GHz Qualcomm Snapdragon 615 • **SCREEN SIZE** 8in • **SCREEN RESOLUTION** 1,920x1,080 • **REAR CAMERA** 8 megapixels • **STORAGE (FREE)** 16GB (10GB) • **WIRELESS DATA** 3G, 4G • **DIMENSIONS** 213x124x8.5mm • **WEIGHT** 338g • **OPERATING SYSTEM** Android 5.1 • **WARRANTY** One year RTB • **DETAILS** shop.ee.co.uk • **PART CODE** Harrier Tab



See page 72 for performance details

BUDGET TABLET

ACER Iconia One 8 B1-820



£126 inc VAT • From www.ebuyer.com

VERDICT

Acer's new Precision Plus touch tech feels limited on the Iconia One 8, but this is still a fast and well-made tablet

TABLETS THAT COME with a stylus for making notes or drawing quick sketches typically come at a price premium. There are exceptions, such as Nvidia's Shield tablet, but the market is dominated by Samsung's top-end Galaxy Note devices. Acer's Iconia One 8 bucks that trend with an ingenious alternative that's kind to your wallet and just as accurate as a Samsung S Pen.

Acer's Precision Plus technology is essentially a grid of touch sensors much smaller than the ones used for touchscreen displays. This grid is so sensitive you can draw directly on the tablet's 8in screen with a regular pencil. After trying our fair share of digital styli, using a regular pencil is a revelation. Drawing feels natural and accurate, more so than other styli we've used in the past. Acer's EZ Note sketching app doesn't have the best selection of brushes to choose from, but you can always use the excellent AutoDesk Sketchbook instead.

BACK TO THE DRAWING BOARD

The 1,280x800 resolution is a bit of a let-down if you want to work on larger sketches, however, and the lack of palm rejection means it's not suited for intricate, detailed drawings. Not being able to rest your hand on the screen without making accidental marks is a bit of a deal-breaker for serious work, but not a major problem for scribbling the odd note.

The grid of touch sensors is so sensitive you can draw directly on the tablet's 8in screen with a regular pencil

Extra sensitivity aside, the Iconia One 8's screen is decidedly average. With an sRGB colour gamut coverage of just 75.1%, it falls behind the Tesco Hudl 2's 79.4%. Reds, magentas, cyans and greens all fell short of the sRGB gamut boundary, which left images lacking depth and vibrancy. This affects your sketches, as colours on the screen may not look the same when you transfer the image to your PC or look at it on another device.

We were pleased with low 0.25cd/m² black levels, and the 1,308:1 contrast ratio ensured that plenty of detail was on show in our test images. However, with a peak brightness of 325cd/m², you'll need to turn the brightness up to max if you want to use the tablet outside.

While not as quick as the Tesco Hudl 2, the quad-core 1.83GHz Intel Atom Z3735G

processor and 1GB of RAM make the Iconia One 8 perfectly snappy for a sub-£150 tablet. Geekbench 3 scores of 643 and 1,860 in the single and multicore tests are just behind the Hudl 2, and Acer's largely stock version of Android felt responsive in our testing.

The 993 score in Futuremark's Peacekeeper web-browsing test is actually a few points in front of the Hudl 2, and it also beats the £400 Lenovo Yoga Tablet 2 Pro. Images loaded in a flash on the *Guardian* homepage, and we could scroll through web pages smoothly even while they were still loading.

A meagre 443 frames (roughly 7fps) in the offscreen GFXBench GL Manhattan test is less encouraging, and the Iconia One 8 didn't meet the minimum specification for Blizzard's *Hearthstone*. We were able to play a couple of rounds with hardly any frame rate drops, though, and those we did see weren't enough to put us off playing. 2D games such as *Alphabear* and *Threes* ran perfectly smoothly.

Battery life isn't that impressive; we only managed 8h 19m from the 4,555mAh battery with the screen brightness set to 170cd/m² in

our continuous video playback test. This beats the Hudl 2 by around an hour, but can't match Acer's claimed figure of 10 hours. Games drain it even faster, too, so you'll probably need to charge it every night.

With only 10GB of the 16GB integrated storage available to the user, the Iconia One 8 has enough room for a few films and games, but you can always expand this using the microSD card slot on the rear of the tablet.

The Iconia One 8 is the first Acer tablet we've seen running Android 5.0. While we could do without the copious app shortcuts and widgets littering the home screens, Acer's decision to stick with vanilla Android means you won't have to contend with any fussy menu layouts. We also like Acer's EZ Wake-up feature, which lets you wake the tablet from

sleep mode by double-tapping the screen, or use five fingers to wake it and launch an app.

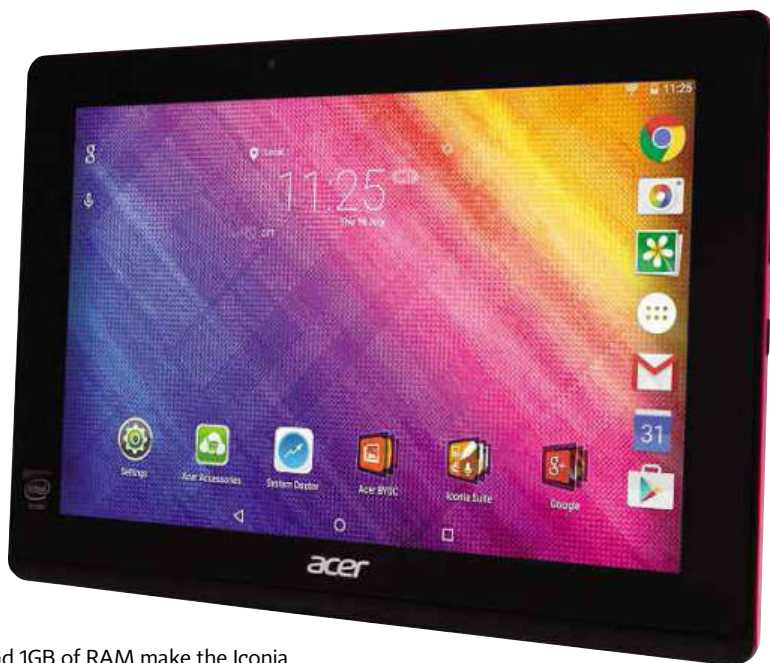
The only downside is that Acer has ditched its own camera app for the basic Google Camera app, so it doesn't have any of the fun customisation modes available on the smaller Iconia One 7. The Iconia One 8's 5-megapixel camera isn't as detailed or well-exposed as the Iconia One 7's snapper, either, as colours were very pink and hazy in our outdoor shots, while indoor shots were riddled with noise.

BUILT TO LAST

This isn't too much of a problem in our eyes, as you're more likely to use your smartphone camera for important family occasions than your tablet. For us, build quality is much more important, and we're pleased to see that the Iconia One 8 is much better made than the creaking Iconia One 7. We didn't find any flex in the rear panel and the textured back, which is available in a wide range of different colours, doesn't feel too cheap and tacky.

Acer's Iconia One 8 isn't as good value as the Tesco Hudl 2, but its Precision Plus touchscreen does give it a fun, extra feature to make it stand out. Its snappy internals are also great for its price, and its excellent build quality and wide range of colours give it more personality than other £130 tablets. If you're not fussed about sketching and want a longer-lasting battery, the £150 Asus MeMO Pad 7 ME572C (*Shopper 330*) is a better buy.

Katharine Byrne



SPECIFICATIONS

PROCESSOR Quad-core 1.83GHz Intel Atom Z3735G • SCREEN SIZE 8in • SCREEN RESOLUTION 1,280x800 • REAR CAMERA 5 megapixels • STORAGE (FREE) 16GB (10GB) • WIRELESS DATA None • DIMENSIONS 214x128x9.5mm • WEIGHT 355g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • DETAILS www.acer.co.uk • PART CODE NT.L9EEE.002



See page 72 for performance details

MINI FLAGSHIP PHONE

LG G4c



£190 inc VAT • From www.carphonewarehouse.com

VERDICT

The G4c has a great battery life and a good camera, but its display is one of the worst we've ever tested

THE G4C IS a miniature version of LG's leather-bound flagship, the G4. Despite the 5in display, it has a smaller, more compact chassis, made possible by moving the power and volume buttons to the back of the phone.

There's no leather here: the G4c is made entirely out of plastic. It has the same curved back as its big brother, and the same diamond pattern as the G4's ceramic and metallic variants, so it bears some family resemblance. It also has a curved display, but with a 3,000mm radius, it's so subtle it's practically non-existent. It's nowhere near as pronounced as the LG G Flex 2, and we struggled to see it even when looking at the phone side on.

Some of the G4's software tweaks make the cut, including Knock Code and Glance View. The former lets you wake the phone by tapping out a personalised lock pattern anywhere on the G4c's screen, while the latter gives you the time, date and any active notifications by swiping down from the top of the screen when it's asleep. Glance View was a tad temperamental, however, either refusing to recognise our swipes or taking too long to respond. You'd be better off just using the power button for checking the time.

GAMUT OF EMOTIONS

The G4c's screen quality is disappointing. Our colour calibrator measured a meagre 65.9% sRGB colour gamut coverage, which is one of the lowest scores we've seen, even among budget handsets. A lack of yellow, green, red and magenta coverage creates a cool colour cast. High brightness levels of 439cd/m² and clean-looking whites help mask this to some extent, but warmer images looked wrong, with skin tones appearing unnaturally pink.

Black levels are also high at 0.47cd/m², but its contrast ratio of 915:1 was more promising, as we could see a good level of detail in all our test photos, even given the 1,280x720

resolution. The screen is prone to picking up fingerprints, though, which not only makes the screen look grimy and grainy, but also means we were constantly having to clean it in order to get a clear, unspoiled picture.

Fortunately, the G4c redeems itself slightly with its excellent battery life. We saw an

impressive 14h 43m in our continuous video playback test with the screen brightness set to 170cd/m². This compares very well to other £200 smartphones, beating the Samsung Galaxy A3, 3rd Gen Moto G and Sony Xperia M4 Aqua by quite some margin.

We were also pleased with picture quality from the 8-megapixel rear camera. The photo app is relatively basic, with no extra modes or HDR shooting, but images were surprisingly decent at the default settings. Colours were rich and natural, and while the overcast weather conditions resulted in a rather bleached-out sky, there was a good level of detail present and hardly any noise.

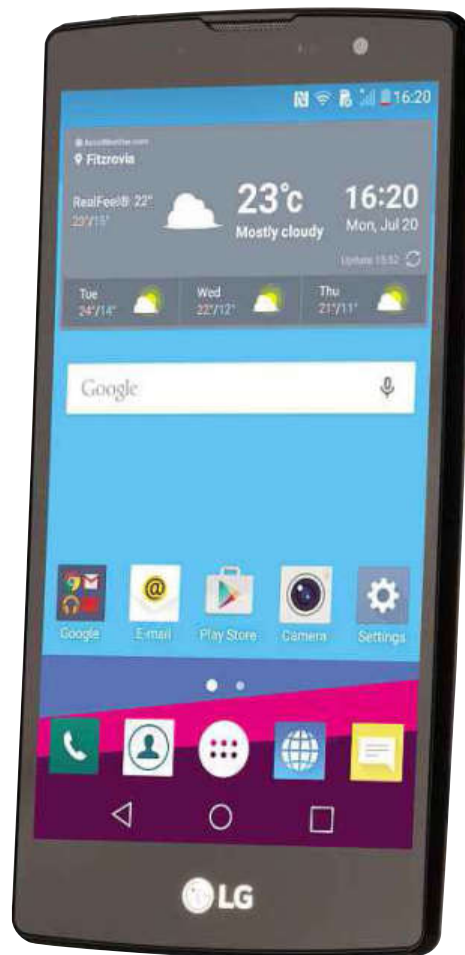
The G4c coped well indoors too. Noise levels increased slightly when relying on natural light, but colours still had plenty of punch and compression was kept to a minimum around the stems of the plants in our still life. Turning on the flash gave everything a rather disappointing blue sheen, but it's better than nothing if lighting conditions are really bad.

TAKING IT SLOWLY

The G4c's rivals really pull ahead when it comes to performance. The quad-core, 1.2GHz Qualcomm Snapdragon 410 processor and 1GB of RAM simply can't compete with the M4 Aqua's octa-core Snapdragon 615, only managing to score 1,405 in the Geekbench 3 multicore test. That's almost 1,000 points behind its 615-based counterparts. 463 in the single core test is also a touch slower than the Galaxy A3, which also uses a Snapdragon 410.

It still has enough speed to run LG's customised Android 5.0.2 skin without too much trouble, but web browsing is noticeably jerkier. While its Peacekeeper browser test score of 632 is roughly in line with what we've seen from other Snapdragon 410 phones, scrolling sometimes took a second too long to respond to our swipes, making it cumbersome to navigate pages at speed.

The G4c's graphics performance is also a little underwhelming, but certainly no worse than other mid-range phones. The G4c managed to produce only 107 frames in the offscreen Manhattan test in GFXBench GL, which is roughly the same as the 3rd Gen Moto G and Samsung



Galaxy A3. Simple games such as Alphabear and Threes ran perfectly smoothly, but more demanding titles such as Blizzard's Hearthstone were a tad jerky.

The G4c isn't best suited to storing lots of games and apps, as only a measly 3.45GB of the 8GB internal storage is available to the user. Fortunately, there's a microSD card slot above the SIM card slot, so you'll need to take advantage of this if you like storing any kind of media files on your phone.

The LG G4c has a reasonable camera and a fantastic battery life, but when it's competing against the likes of Sony's Xperia M4 Aqua, the Samsung Galaxy A3 and the 3rd Gen Moto G, its poor screen, small amount of storage and mediocre performance simply doesn't measure up. For us, the 3rd Gen Moto G is our preferred budget handset, but those after an even better bargain are much better off buying the £125 Vodafone Smart Ultra 6.

Katharine Byrne



SPECIFICATIONS

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 410
SCREEN SIZE 5in • **SCREEN RESOLUTION** 1,280x720 •
REAR CAMERA 8 megapixels • **STORAGE (FREE)** 8GB
 (3.45GB) • **WIRELESS DATA** 3G, 4G • **DIMENSIONS**
 140x70x10.2mm • **WEIGHT** 136g • **OPERATING SYSTEM**
 Android 5.0.2 • **WARRANTY** One year RTB • **DETAILS**
www.lg.com/uk • **PART CODE** LG-H525N



For better bedroom performance.

Simply plug in and enjoy excellent Wi-Fi coverage in any room over your electric circuit: devolo Powerline.



The **dLAN® 1200+ WiFi ac Starter Kit** enables Wi-Fi without signal loss anywhere in your home:

- Fastest Wi-Fi connection of all time
- Plug & Play installation
- Award winning German technology
- 3 years guarantee

www.devolo.co.uk

amazon.co.uk

[John Lewis](#)

The electronics specialist
[maplin](#)

[PC World](#)

devolo

BUDGET SMARTPHONE

VODAFONE Smart Ultra 6

COMPUTER SHOPPER

★★★★★

BEST BUY

£125 inc VAT • From shop.vodafone.co.uk

VERDICT

With its powerful specs and wallet-friendly price, the Smart Ultra 6 sets a new benchmark for budget smartphones

THE SUPER-SIZED Vodafone Smart Ultra 6 is something of a budget miracle. For £125 on Vodafone's pay-as-you-go or £17 a month on contract, you get a 5.5in, 1,920x1,080 display, a 13-megapixel camera, 16GB of storage, a 3,000mAh battery and the same Snapdragon 615 processor that powers the £200 EE Harrier and £225 Sony Xperia M4 Aqua.

It's also well made: while the grey, 8.4mm thick unibody isn't particularly eye-catching, it fits in with Vodafone's other own-brand devices and its lightly ribbed sides give your fingers something to hold on to when you're using it with one hand.

TOP OF THE LEAGUE

Performance is truly astonishing for such a cheap handset. The Snapdragon 615 chipset is paired with 2GB of RAM to push the Smart Ultra 6 leagues ahead of anything else in this price range, putting our current budget favourites, the £145 2nd Gen Moto G and £110 2nd Gen Moto E, to shame. In Geekbench 3's single and multicore tests, the Smart Ultra 6

As a result, its GPU is much better equipped to deal with demanding games such as Blizzard's Hearthstone; battle animations were smooth and text bubbles didn't stutter at all.

The large screen makes playing any sort of game a delight. Admittedly, picture quality isn't exactly stellar, with our colour calibrator only measuring 84.7% coverage of the sRGB colour gamut, but compared next to the Moto G and its 87.2% coverage it was difficult to spot any difference. Colours looked almost identical in terms of tone and saturation, and both looked equally pleasing to the eye.

BRIGHT AND BEAUTIFUL

If anything, the Smart Ultra 6's higher 498cd/m² peak brightness gives colours a bit of extra punch, as Motorola's handset only reaches a maximum brightness of 351cd/m². High brightness levels don't affect black levels too much either, as a reading of 0.42cd/m² is roughly around average. A high 1,179:1 contrast ratio means there's plenty of detail, and viewing angles are lovely and wide.

Performance is truly astonishing for such a cheap handset and is leagues ahead of anything else in this price range

scored 636 and 2,148 respectively; miles in front of the Moto G's 341 and 1,156.

As a result, navigating Android 5.0.2 feels much faster on the Smart Ultra 6 than it does on the Moto G, and web browsing is similarly nippy. Image-heavy web pages load quickly, with no hitches in performance when scrolling or panning desktop websites. A Peacekeeper browser test score of 741 puts the Smart Ultra 6 only slightly behind the LG G4's 841, despite being a fifth of the price.

Graphics performance is good, too. While a score of 346 in the GFXBench GL 3.0 Manhattan test only equates to around 5.6fps, it's still much better than the Moto G's 110 frames, or 1.8fps.

Despite the large, high-resolution screen, battery life is impressive. With the display's brightness set to 170cd/m², the Smart Ultra 6's 3,000mAh battery lasted 10h 51m in our video playback test, so it should be more than capable of lasting all day.

The 13-megapixel camera on the back of the handset produced some pleasing images, with vivid colours and plenty of crisp detail, despite a tendency to leave areas of shadow looking rather dark. We'd recommend sparing use of HDR mode, though, as this tended to leave colours looking slightly bleached out and produce unrealistically saturated images.

The comprehensive camera app has a variety of filters, smile detection, panorama shooting, interval capture for taking multiple shots on an automatic countdown timer, and multi-exposure for combining multiple images to create arty layered shots.

There's also a Manual mode that lets you adjust the white balance, ISO and exposure levels, as well as toggle grid lines, and a horizon guide to help you capture perfectly aligned shots.



As a Vodafone-branded handset, the Smart Ultra 6 naturally includes several pre-installed Vodafone apps. Some are more useful than others, but thankfully you can uninstall them to free up a bit of extra storage space. You'll want to keep the Vodafone Start and Message+ apps, though, as the former lets you keep track of your data allowance, monthly texts and minutes, while the latter provides sent, delivered and read notifications when you send texts and lets you chat with multiple Message+ users in the same thread.

With so many practical features, the Smart Ultra 6 is unbelievably good value. While contract prices put it in more direct competition with the likes of the Sony Xperia M4 Aqua, which is arguably more attractive and has better build quality, it's a real steal on pay-as-you-go; with its larger, higher-resolution screen and superior camera, it completely blows the 2nd Gen Moto G out of the water. If you don't mind joining Vodafone, the Smart Ultra 6 is an incredible bargain.

Katharine Byrne

SPECIFICATIONS

PROCESSOR Octa-core 1.7GHz Qualcomm Snapdragon 615 • SCREEN SIZE 5.5in • SCREEN RESOLUTION 1,920x1,080 • REAR CAMERA 13 megapixels • STORAGE (FREE) 16GB (11GB) • WIRELESS DATA 3G, 4G • DIMENSIONS 154x77x8.4mm • WEIGHT 159g • OPERATING SYSTEM Android 5.0.2 • WARRANTY One year RTB • DETAILS www.vodafone.co.uk • PART CODE Smart Ultra 6



The Home Of Award Winning Computer Systems

BACK 2 SCHOOL

Displays



From **£59**

Printers



From **£25**

Desktops



From **£99**

Notebooks Bags



From **£5**

Gaming Systems



From **£299**

Other Accessories



Notebooks



From **£195**

Tablets



From **£45**

Computer Components



Custom Built Systems



From **£199**

USB Storage



From **£5**

CD/DVD Media



From **£2**



For Low Low Prices on 1000s of Computers Products Visit
www.eclipse-computers.com

COMPACT SYSTEM CAMERA

PANASONIC Lumix DMC-G7

COMPUTER SHOPPER ★★★★★
BEST BUY

£599 inc VAT • From www.wexphotographic.com

VERDICT

With sophisticated autofocus, superb controls and 4K video capture, the Panasonic G7 packs a serious punch

THE PANASONIC G1 was the world's first compact system camera (CSC), but after a trailblazing start, other CSCs soon caught up with smaller, faster and more handsome designs that arguably took better pictures. Even so, the Panasonic G6 (see *Reviews, Shopper 308*) had no real weaknesses – if you could forgive its dull appearance. It was responsive, with elegant controls, an articulated touchscreen, a large electronic viewfinder and lots of fun shooting modes.

Two years later, the G7 shares the G6's reliable utilitarian spirit, but a slew of new and improved features makes this a significantly more upmarket camera.

CONTROL CENTRE

The most visible change is the introduction of extra controls. The G6 had a command dial but the G7 has two, giving access to aperture and shutter speed in manual exposure mode. In priority modes, one dial controls exposure compensation. Pressing one of two top-mounted buttons assigns other functions, which can be customised in the menu.

There's a drive mode dial to the left of the viewfinder, plus a switch for single auto, continuous auto and manual focus. You can also use the touchscreen to move the autofocus point when composing shots with the viewfinder. It's fast and intuitive, especially as the G7 isn't limited to predefined autofocus points. The handgrip has been redesigned for comfort and feels secure, even with a heavy lens attached.

With so many physical controls, the G7 might seem overly complex, but beginners can ignore them and leave the camera in Auto

mode. As requirements and confidence grow, having dedicated controls makes it easier to learn manual settings.

The G6's electronic viewfinder (EVF) was excellent but the G7's is even better. It has the same 1.4x magnification (equivalent to 0.7x on a full-frame SLR) but a higher resolution – up from 1.44 million to 2.36 million dots. While the extra resolution wasn't particularly noticeable, its richer colours were.

The G7 focuses twice as fast as the G6, averaging 0.3 seconds between pressing the shutter button and capturing a shot. This means a marked improvement in shot-to-shot times, rattling off three shots per second in normal use. In continuous mode it fired off 101 JPEGs at an astounding 8.3fps, or 6.1fps with continuous autofocus. Raw continuous capture was at 6.7fps for 17 frames, or 5.3fps for 19 frames with continuous autofocus, before slowing to 1.8fps. SLRs at this price can't match this performance.

Panasonic leads the way for 4K video capture, and it's great to see the mid-price G7 getting 3,840x2,160 shooting at 24 or 25fps. Fine detail in 4K footage was far beyond anything we've seen at 1080p, even after downsizing to fit a 1080p monitor. It also gives scope to crop the video or apply stabilisation effects without sacrificing detail. Footage looks stunning at native resolution.

Video mode is up to scratch in other areas too. The Cinelike D colour profile produces flat, low-contrast colours that are an ideal starting point for software colour grading. There's touchscreen control of the autofocus point, tracking focus and spot metering, plus manual control over shutter speed, aperture, ISO speed and mic level while recording.

It also has 4K Photo mode, which records at 30fps and allows individual frames to be saved as 8-megapixel JPEGs.

You can capture at 4:3, 3:2 and 1:1 aspect ratios as well as the usual 16:9 used for video.

The 8-megapixel image is a crop of the 16-megapixel sensor, which gives lenses a 2.6x crop factor – up from the usual 2x for Micro Four Thirds. While that's not so good for

wide-angle photography, it shouldn't be a problem for sports and wildlife.

The one area in which the G7 doesn't excel is image quality. The Micro Four Thirds sensor is about two-thirds of the size of the APS-C sensors in CSCs from Sony, Canon and Fujifilm, and noise levels are higher as a result. We'd happily push other CSCs to ISO 6400 in low light, but the G7 is best limited to 3200.

FOCAL TECHNIQUE

Rival cameras also have higher resolutions, but 16 megapixels is ample for most purposes. The sharp kit lens and excellent JPEG engine made the most of it to deliver crisp details. Automatic exposures were expertly judged, with the camera responding intelligently to moving subjects to avoid motion blur.

The G7 has two superb cameras to compete with. The Canon EOS 750D is a true SLR that doesn't put a foot wrong and beats the G7 for image quality. The G7 is faster in continuous mode, though, with a larger viewfinder and more controls. Then there's Sony's a6000 (see *Reviews, Shopper 319*), which costs around £500. It's smaller and lighter, it's even faster in continuous mode and narrowly beats the G7 for image quality, although it too can't match the G7's controls.

The G7 is the clear victor for video capture, and its fast, flexible, touchscreen-operated autofocus system is the best of the bunch. That makes it at least as good in our view, and equally deserving of a Best Buy award.

Ben Pitt



SPECIFICATIONS

SENSOR RESOLUTION 16 megapixels • **SENSOR SIZE** 17.3x13mm • **FOCAL LENGTH MULTIPLIER** 2x • **VIEWFINDER** Electronic (2,360,000 dots) • **LCD SCREEN** 3in (1,040,000 dots) • **OPTICAL ZOOM** (35mm-EQUIVALENT FOCAL LENGTHS) 3x (28-84mm) • **35mm-EQUIVALENT APERTURE** f/7-11.2 • **LENS MOUNT** Micro Four Thirds • **WEIGHT** 525g • **DIMENSIONS** 87x135x108mm • **WARRANTY** One year RTB • **DETAILS** www.panasonic.com/uk



ULTRA HD MONITOR WITH FREESYNC

SAMSUNG U32E850R

COMPUTER SHOPPER



RECOMMENDED

£900 inc VAT •

From www.overclockers.co.uk

VERDICT

A practical office monitor, but the U32E850R is about as expensive as they come

LIKE MOST OF Samsung's high-end monitors, the U32E850R has a list of features that will make an enthusiast's mouth water. With so much desirable technology on board, including a 32in Ultra HD panel that uses Samsung's own PLS technology and AMD's FreeSync adaptive refresh rate, the price is understandably high.

We're a little disappointed with its styling, though. Samsung monitors typically have brushed silver bezels that taper into the screen surface, but not this one. Here you get huge 15mm bezels in black plastic. Considering the price, it's irksome that Samsung hasn't produced a better design.

At least the frame and stand are robust, as they need to be with such a large monitor. Give your desk a shake and you'll get a bit of wobble, but that's to be expected. You have around 130mm of height adjustment – up to a height of 200mm – and the monitor swivels and rotates on its arm so you'll never have trouble getting it into the right position.

SENSE OF SCALE

Depending on your eyesight, you may wish to bump up Windows' scaling to cope with the 3,840x2,160 resolution – we had no trouble reading size-11 text at 100% zoom settings, but anything smaller requires 125% or more. Viewing angles are wide, which is handy with such a large screen because the corners are always a fair distance away from your eyes.

Colour performance is respectable, although our calibrator measured a default colour temperature of 6291K, which looks a little warm for our liking. The monitor was able to display 98.6% of the sRGB colour gamut, producing colours that are vibrant but slightly softened by the warm colour temperature. Office users will probably be less bothered by the warm tones, as it's softer on the eyes.

Samsung's Magic Bright setting worked best in Standard mode, as it drops brightness to 30% – much more manageable than the default setting of 100, which produces in excess of 350cd/m². Dynamic Contrast and Cinema modes are available too, but Standard was the most comfortable for work.

The backlight is slightly uneven, with the bottom-right corner nearly 20% brighter than the top-left. This was quite noticeable, with objects in the bottom-right of the screen brighter than those around it. This may put off designers and photographers, but it shouldn't cause problems for general office work.

We measured black luminance at 0.4cd/m², which



is a little higher than we'd like but perfectly adequate for office conditions, even if it has an effect on movies and photos. Contrast is relatively high at 891:1, with plenty of detail visible in subtle shades, particularly in brighter and more vibrant images.

REFRESHING CHANGE

We measured input lag at an impressively low 10ms with our Leo Bodnar lag tester, which is ideal when playing games that rely on quick reactions. Connecting the E850 to an AMD graphics card over DisplayPort allows the graphics card to tell the monitor when to refresh using AMD's FreeSync, which should eliminate frame tearing in games. However, the frame rate band in which this works is narrow – you'll need a game that runs at between 40 and 60fps to benefit. You'll still get tearing if your game dips below 40fps or above 60fps.

Also keep in mind that playing a game on a 4K monitor requires some serious graphics hardware. The Nvidia GeForce GTX 980 (£400) and AMD Fury X (£440) are the bare minimum we'd recommend.

You can boost contrast and sharpness using the Game mode, making it easier to spot hidden foes in the dark corners of rooms. It's great for competitive gamers who want to see everything but kills the atmosphere in games where tension and fear are your key motivators for playing.

The DisplayPort and Mini DisplayPort inputs support 3,840x2,160 resolutions at 60Hz, as do the two HDMI 2.0 ports, so you can have multiple Ultra HD sources hooked up to your monitor. There's also picture-in-picture and picture-by-picture modes, but only for a maximum of two inputs.

Two USB3 connectors sit alongside the display inputs, and two more are within easy reach on the rear of the monitor, facing to the left. This is an improvement over previous Samsung designs, which had the ports facing backwards where they were extremely hard to reach.

The Samsung U32E850R is an expensive way to get Ultra HD onto your desk, especially when smaller, cheaper and more practical models are available, such as AOC's 34in, Ultrawide U3477PQU or the 27in Asus PB279Q. The uneven backlight also puts a small dent in its otherwise impressive image quality. As an office monitor, though, the Samsung U32E850R is hard to beat for practicality.

Michael Passingham

SPECIFICATIONS

SCREEN SIZE 32in • RESOLUTION 3,840x2,160 •
SCREEN TECHNOLOGY PLS • REFRESH RATE 60Hz •
VIDEO INPUTS DisplayPort, Mini DisplayPort, 2x HDMI •
WARRANTY Three years collect and return • DETAILS
www.samsung.com/uk

CONNECTION PORTS

DisplayPort

Mini DisplayPort

HDMI x2



ECLIPSE
COMPUTERS

www.eclipse-computers.com

08444 723 723

106 St Nicholas Street, Coventry, CV1 4BT
Mon-Fri 9:30am-6:00pm, Sat 9:30am-3:30pm

**The Home Of
Award Winning
Computer Systems**

Home & Office PCs



Bring your digital world to life with these Great value systems ideal for Home, Office or Students.

From **£199.95**

Custom Gaming PCs



Less Work... More Play... Immerse yourself in the world of Games and achieve mega tasking with ease.

From **£349.95**

Xtreme Gaming PCs



Amazing performance and stunning visuals with a boost. Raise the bar and Rule Your Game.

From **£999.95**

Media Centre PCs



Bring the PC & digital life to the Big Screen in your living, all from the comfort of your sofa.

From **£299.95**

**You Spec It...
We Build It...**

Over 240,000 Systems
Configured Online
& Counting...

www.eclipse-computers.com

HIGH-END PROJECTOR

EPSON EH-LS10000



£5,995 inc VAT • From www.puretheatre.com

VERDICT

Incredible Full HD image quality, but we're not fully convinced by the EH-LS10000's 4K enhancement

ULTRA HD VIDEO is only starting to make inroads into the mainstream, which makes buying a new projector a tricky decision. With little native 4K content available, 4K projectors feel like expensive exercises in future proofing, yet it could be naïve to buy a Full HD model when 4K is just around the corner. Epson's EH-LS10000 throws another variable into the mix: 4K enhancement.

This projector doesn't display native 4K video, but it takes Full HD content, such as Blu-ray discs and games, and enhances it, remastering the result into a 3,840x2,160 resolution image. It does this by producing two images for every projected frame, with one frame shifted diagonally by half a pixel. Because the frames are replaced so quickly, they look like a single frame. While this alone doesn't necessarily improve image quality, complex algorithms that detect the edges of objects and fine details such as hair and dirt create a well-balanced, detail-packed image.

RAY OF LIGHT

Epson has opted for a laser projection system instead of a conventional lamp, which has a huge impact on image quality and the projector's lifespan. It uses two blue lasers, one of which provides blue light while the other is turned yellow by passing through a spinning yellow phosphor wheel. This is split again into red and green using dichroic mirrors. The theory is that the projector produces more vibrant colours, deeper blacks and less heat, and it starts up instantly, with no warm-up procedure. However, you can't replace the lasers when they eventually deteriorate, so you'll need a new projector.

One popcorn crumb of comfort is that its 30,000-hour lifespan is equivalent to watching a two-hour film every day for a little over 41 years. Not having to replace bulbs that typically cost in excess of £300 will be a huge cost saving and should be taken into account.

The projector offers 10 image processing settings labelled 1 to 5 and 4K-1 to 4K-5. The first five use conventional image processing to create more detail and increase contrast,

while the second set employs 4K enhancement – in theory giving detail levels an even bigger boost. However, no single enhancement setting suits all media, and your preference will be down to personal taste and the sort of content you watch.

In Blu-ray movies with lots of film grain, such as our *Star Trek* test disc, the 4K enhancement options made everything look messier than the Full HD settings. The details of Kirk's hair as he speeds down a desert road, for example, looked much less well defined with 4K enhancement set to 2 compared with Full HD enhancement set to 5. Even worse, turning up the 4K enhancement options to 5 resulted in an unnatural and harsh-looking image that doesn't work in a darkened home cinema environment.

There were times when 4K enhancement was the better choice, though, with a *Nine Inch Nails* concert revealing beads of sweat and incredibly sharp hair detail. Everything looked more defined than in native Full HD.

This 4K processing also eliminates the so-called 'screen door' effect visible on most projectors, where the tiny gaps between pixels on the LCDs are visible on your projection surface. Unless you sit extremely close to the screen, however, you're unlikely to notice them at all, so this is a very niche benefit and shouldn't influence your buying decision.

In general, we preferred to use the highest Full HD processing setting. Stars that looked like blurry pinpricks without image processing were transformed into bright, vibrant patches, while the sky around them remained inky black, thanks to the projector's high (although unspecified) contrast levels. Daylight shots also looked incredibly vibrant.

The smooth, judder-free movement produced by Epson's frame interpolation was impressive without becoming overbearing. The projector offers multiple levels of processing, but the default option is easily the best. Turning it down or off obviously leads to more judder, and turning it all the way up gives you a 'soap opera' effect, where everything looks uncomfortably smooth.



Using 4K enhancement disables this feature, but because of the rapid refresh rate, this has less of an effect than you might expect.

The EH-LS10000 has a rated brightness of only 1,500 lumens, which is fine for a dark room but is easily overwhelmed by overhead lighting or natural light. You should invest in proper blackout curtains if you're spending £6,000 on a projector.

DOWNSIZING

As the EH-LS10000 can't play native 4K video, Epson hasn't fitted HDMI 2.0 ports, although it does have HDCP 2.2 copy protection. This means that while it won't project in Ultra HD (instead it downscales to 1080p then 'enhances' back up to 4K), you'll be able to plug in a 4K Blu-ray player when they arrive.

It also offers a full complement of physical lens adjustments. Lens shift, zoom, focus and keystone are adjusted with the backlit remote control. You can save 10 lens configurations, which helps when you have a library of video in varying aspect ratios and don't want to have to adjust your projector each time.

The EH-LS10000 is a tricky beast. Its lack of native 4K projection is a concern, but its image quality is fantastic. The laser projection system also means maintenance costs will be extremely low. For £500 less, however, you can buy the Sony VPL-VW300ES, which edges out the Epson for image quality thanks to its native 4K projection.

As a high-end Full HD projector, the Epson EH-LS10000 is brilliant, and if you're in the market for a Full HD device, it's a great buy. Just consider your options before you commit to several more years of Full HD content.

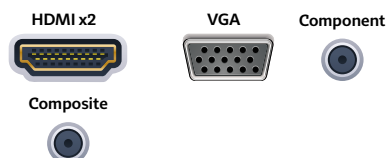
Michael Passingham



SPECIFICATIONS

PROJECTOR TYPE Three-chip LCD, laser • **NATIVE RESOLUTION** 1,920x1,080 • **VIDEO INPUTS** 2x HDMI, component, VGA, composite • **LAMP LIFE** 30,000 hours • **LAMP BRIGHTNESS** 1,500 lumens • **DIMENSIONS** 225x550x553mm • **WEIGHT** 18kg • **WARRANTY** Three years RTB • **DETAILS** www.epson.co.uk • **PART CODE** EH-LS10000

CONNECTION PORTS



Vigor 2860 Series

The Ultimate 'xDSL' Router

- ADSL2+ and VDSL and broadband router/firewall
- IPv6 support - The new Internet protocol
- 3G / 4G (Cellular) Modem support
- Built-in simultaneous dual-band WiFi & 802.11ac
- Comprehensive and robust firewall
- VPN site-to-site and teleworker connectivity
- Configurable QoS (traffic prioritisation)
- 6-Port Gigabit Ethernet Switch
- Content Filtering (by keyword or data type)
- 802.1q VLAN tagging & multiple subnets
- Twin phone ports for VoIP (Option)
- Managed Wireless for DrayTek APs - New



Vigor2760 Series

ADSL/VDSL Router

- ADSL, ADSL2+ & VDSL Router Firewall
- Ideal for SoHo & Teleworkers
- 3G/4G USB Modem Support
- Native IPv4 & IPv6 dual-stack support
- Gigabit Ethernet LAN Ports
- NAS facility using USB-based storage
- Robust firewall with object-based rules
- Dial-out VPN - connect to HQ
- QoS for traffic prioritisation
- Twin phone ports for VoIP (V' models)
- Internet Content Filtering



Do you use a router or WiFi ?

If you use or operate a router or WiFi network, of any brand, you are a target for hackers or criminals. Read our essential white paper "The 27 things every router user should know". Download it free from

www.draytek.co.uk/best



AP-910C Access Point

Ceiling or Wall 802.11ac

- Business Class Wireless Access Point
- Ceiling or Wall Mounted
- Rear or side cable access
- Simultaneous Dual Band (2.4/5GHz)
- Latest 802.11ac technology
- PoE Powered (or DC) as standard
- Gigabit Ethernet
- Multiple Security Facilities
- Standalone or Centrally Managed VLANs & Multiple SSIDs



Vigor2925 Series

Dual-WAN Ethernet

- Dual-WAN Ports (Gigabit Ethernet)
- IPv4 / IPv6 Support
- 3G/4G USB Modem support
- Internet Content Filtering
- Load-balancing & WAN failover
- QoS Prioritisation
- SSL & IPSec VPN



DrayTek Managed Wireless

DrayTek's new managed wireless facility is built into the Vigor 2860 router - Just add DrayTek wireless access points and your users and guests can have reliable coverage and optimised performance, whilst you have control, security and comprehensive monitoring.

- No dedicated/specialist controller required
- Mobility - Wireless throughout your premises
- Load-Balancing across multiple APs
- Reporting, logging & monitoring
- Security & isolated guest access

Learn more at www.draytek.co.uk/wireless



VigorSwitch

Gigabit & PoE Switches

- Gigabit Smart or L2 Managed
- 8 or 24 Port Full Power PoE
- PoE models to power:
 - IP Phones
 - IP Cameras
 - Access Points



Vigor 2960 / 3900

High Performance Routers

- 2 or 4 Gigabit WAN Ports
- Load-balancing & failover
- 500 or 1000Mbps Firewall Throughput
- 200 or 500 IPSec VPN Tunnels
- SSL VPN
- IPv6 & IPv4 dual-stack
- Internet Content Filtering



DrayTek

For the full range, visit
www.draytek.co.uk

All specifications subject to change. 09/13
Please check web site for current model specifications.

BLU-RAY PLAYER

SAMSUNG BD-J7500

COMPUTER
SHOPPER
RECOMMENDED



£150 inc VAT • From www.currys.co.uk

VERDICT

The Samsung BD-J7500 is a stylish Blu-ray player with a wealth of apps and services

MORE AND MORE of the video we watch might be provided digitally, but that's not to say many of us don't still buy films and TV series on discs. Samsung's latest Blu-ray player is as feature-packed as they come, so although you'll need to find room under your TV for it, the BD-J7500 easily justifies the extra space it occupies over an Amazon Fire TV or Apple TV streaming media box.

With a simple menu interface divided into three main sections for Blu-ray playback, multimedia and Samsung Apps, the BD-J7500 is undeniably comprehensive. The Multimedia section lets you play content from network storage using DLNA, or directly from a USB flash drive plugged into the USB port on the front of the player. It detected the folder structure of a network-attached NAS perfectly, and Plex users will be pleased to hear that their preferred media library and server software is supported too. This makes it easier to play content off any network media server running the Plex software, including a PC.

STREAM LOVER

The Samsung Apps section contains a number of preinstalled apps, but you can also download the catalogue to get more. Once the BD-J7500 is online, either over Wi-Fi or Ethernet, you'll be able to access video on-demand and catch-up content from every terrestrial UK television channel. Streaming video mainstays such as Netflix, Amazon Instant Video and YouTube make an appearance too, while music streaming is available through Spotify and Deezer.

We were pleased to see that most of these third-party apps use their own software keyboards, because Samsung's default onscreen keyboard is blighted by lag and feels very slow. Thankfully we only had to use it briefly for entering the network password. The rest of the Smart Hub interface felt responsive, even if apps took a few seconds to load, but essentially it was on a par with other smart TV and Blu-ray player interfaces for speed. Playback began just a few seconds after we'd inserted a Blu-ray disc.

You can control the BD-J7500 using touch-sensitive controls on the top of the player. Subtle backlit LEDs indicate power, eject, play/pause and stop, but they dim during playback, making them difficult to find in the dark. Most people will rely on the included remote control, which has all the settings you would expect in a relatively compact unit.

The LCD on the front of the player indicates whether it's playing from a disc or streaming content from one of the apps. It's equally subtle and won't create much of a distraction when you're watching movies at night. The slim, stylish player is no deeper than a Blu-ray disc case, with a black and grey exterior finish that should match most TVs.

The player has a pair of HDMI outputs on the back, which is ideal if you own a projector, as you can connect the player to your TV and projector simultaneously, saving the need to rewire everything when you want to watch on the big screen. You could also use the second



HDMI to relay audio to an AV amplifier that doesn't support 3D video. There are analogue outputs for up to 7.1 surround sound, or you can fall back to optical TOSlink if your amplifier lacks HDMI. If you own any Samsung M-Series wireless speakers or soundbars, you can connect the BD-J7500 to play CDs through every speaker in a system.

The other feather in the BD-J7500's cap is its ability to upscale video to 4K resolution. While this is a handy feature, especially for those who have been quick to buy a 4K-capable television, its usefulness may be short lived as native 4K (UHD) Blu-ray discs could be with us as soon as Christmas, removing the need to make do with upscaling.

What's more, unless you have a particularly cheap 4K television, it will probably do just as good a job of upscaling anyway.

PICTURE OF HEALTH

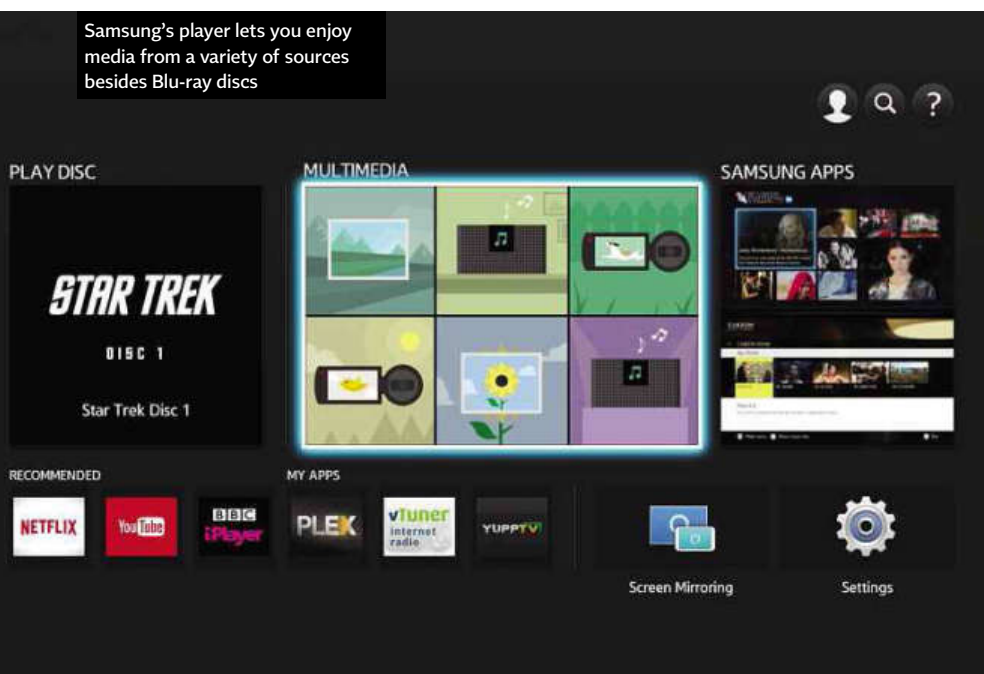
Image quality was as good as we'd expect from a higher-end Samsung player, with plenty of crisp detail from our Full HD test Blu-rays. Contrast could have been a bit more pronounced out of the box, but the user controls allowed us to tweak the colours and contrast more to our taste. Its 4K upscaling looked relatively subtle when viewed on a UHD TV, so don't expect the BD-J7500 to work miracles with non-native 4K content, but anyone who has a library of DVDs will be pleased to hear that Full HD upscaling looked very good, as did 3D Blu-ray discs.

The BD-J7500 proves itself as an all-in-one entertainment hub, with streaming service support that rivals that of media players from Roku and Amazon. It's a highly capable Blu-ray player too. How useful its 4K upscaling is remains to be seen now that UHD Blu-ray discs aren't very far away, but if you're not bothered by UHD content, it's a great overall package with plenty of added value.

Richard Easton

SPECIFICATIONS

BLU-RAY PROFILE 5.0 • 3D CAPABLE Yes • DIMENSIONS 360x224x39mm • NETWORKING Ethernet, 802.11ac Wi-Fi • WARRANTY One year RTB • DETAILS www.samsung.com/uk • PART CODE BD-J7500





Intel i5 Elite (HAS9)

INTEL Core i5 4690K (O.C 4.6Ghz*)
 ASUS Z97-P Motherboard
 Crucial Ballistix 8GB 1600Mhz
 Samsung 24x DVDRW
 CoolerMaster Elite 430
 450W Corsair PSU
 Nvidia GTX750 2GB
 Windows 10 64Bit

£599.99



alphr
 ★★★★★

Intel i7 Elite (HAS11)

INTEL Core i5 4790K (O.C 4.6Ghz*)
 ASUS Z97-Pro Gamer Motherboard
 Crucial Ballistix 16GB 1600Mhz
 256GB Crucial SSD Sata3
 Samsung 24x DVDRW
 Thermaltake Core V51
 750W Corsair PSU
 Nvidia GTX980 2GB
 Windows 10 64Bit

£1299.99



expertreviews
 RECOMMENDED

0% Finance Available - Buy Now Pay Later*

Terms & Condition apply - see www.policomp.co.uk

Q-Jump Service Available - Next Working Day Dispatch

Free Games on all Gaming PC's

PC range starting from £119.99 with Windows included

Intel Evolve 750 Gamer (INT3)

INTEL Skylake Core i5 6600K
 ASUS Z170-P
 Crucial 8GB DDR4 2133Mhz
 Kingston 120GB SSD Sata3
 Samsung 24x DVDRW
 Zalman Z3 case
 450W Corsair PSU
 AMD R7 370 4GB
 Windows 10 64Bit

£749.99



INTEL Skylake

AMD Nemesis Cube (NEM1)

AMD Athlon X4 860K (O.C 4.2Ghz)
 ASUS A88XM-Plus Motherboard
 Crucial 8GB 1600Mhz
 Seagate 1TB HDD Sata3
 Samsung 24x DVDRW
 Bifenix Prodigy Case
 550W PSU
 AMD R7 270 2GB
 Windows 10 64Bit

£599.99



expertreviews
 RECOMMENDED

AWARD WINNING PC SYSTEMS - QUALITY SUPPORT

**FREE Q-JUMP
 CODE - CSQJFREE**
Add at checkout to be applied



No Bloatware - 100% Stability Tested - Windows Disc supplied

WIRELESS SOUNDBAR

EVOLVE AUDIO SB-2501



£200 inc VAT • From www.amazon.co.uk

VERDICT

An inexpensive yet effective home cinema audio upgrade

WHEN YOU CONSIDER the extras that come with the Evolve Audio SB-2501, you may be surprised to learn that it's one of the least expensive soundbars we've tested. As well as the main unit, you get a wireless subwoofer and even a pair of Bluetooth headphones for private listening, all for £200.

The SB-2501 doesn't even look like a budget soundbar. It may not be the most stylish one we've seen, but it has an understated charm with its combination of gunmetal-grey brushed-aluminium body and black fabric speaker grilles. The compact size means it won't look out of place under 37in or smaller TVs either.

The same can't be said of the rather plain wireless subwoofer, but thankfully it's small

The bundled remote control is ridiculously simple, with buttons for changing inputs and audio effects, separate controls for volume and subwoofer bass, a Bluetooth toggle and not much else. Thankfully, a display dimmer reduces the brightness of the LEDs in case you find them distracting.

Connectivity is basic, with just a pair of RCA jacks, a 3.5mm stereo jack and an optical S/PDIF connection. There's no HDMI here, so you'll have to use the optical connection for the best sound quality. You can also connect using the less lossy Bluetooth aptX codec if your device supports it.

Sound quality from the SB-2501 is very respectable considering the low price, and is almost certainly an upgrade over your television's built-in speakers

enough to hide out of sight behind a sofa. We managed to place it nearly 10m away from the soundbar without losing the connection.

We're not particularly fond of the bank of LED status indicators Evolve has slapped in the middle of the soundbar, either in form or function. They're a little distracting, and with no labels to tell you what they mean, you have to remember which combination of lights corresponds to which sound mode.

As you'd expect, the Music, Movies, News and Sport modes all emphasise different sound elements, but as there's no way of making fine equalisation adjustments beyond bass control on the subwoofer, it's worth experimenting with the different effects as you change input sources or musical genres.

A surprise inclusion with the SB-2501 is the pair of wireless headphones. These are perfect for late-night movie watching or listening to music when you don't want to disturb the household, but they're also incredibly useful for anyone who has hearing difficulties. Instead of turning up the soundbar's volume to levels that are potentially uncomfortable for viewers with more sensitive ears, you can use the headphones simultaneously, as they have their own independent volume control.

By default, turning on the headphones mutes the soundbar automatically, so you'll need to unmute it if you want simultaneous sound. Sensibly, the soundbar also remains in mute when you turn the headphones off.

The headphones themselves aren't particularly attractive or well built. The earcups and headband are comfortable enough but they're backed by cheap-feeling plastic. The volume and power buttons are also integrated into the back of one of the earcups and can be tricky to press. You can charge them over Micro USB, though, and there's a convenient USB port on the wireless subwoofer that you can use. They typically lasted eight to 10 hours on a full charge.

Sound quality from the SB-2501 is very respectable considering the low price, and is almost certainly an upgrade over your television's built-in speakers. The soundbar outputs a relatively reserved 60W, but that's still more than loud enough to fill a medium-sized room. The six 40mm drivers deliver a reasonably crisp sound.

You won't get a completely realistic surround sound experience, even from the SB-2501's 3D sound mode, but dialogue sounded clearer through the soundbar and the 60W subwoofer delivered emphasis in the lower frequencies that's likely to be absent from your television's speakers. Music sounded equally good for the money, with respectable mid and treble delivery.

As an inexpensive audio upgrade, the Evolve Audio SB-2501 is impressive. It's not the most attractive soundbar in the world, but it has a reasonable set of features and the wireless subwoofer is a real plus point at this price. Not everyone will need the wireless headphones, but they're a welcome inclusion and don't bump up the cost dramatically. If you can live without the extensive array of connections you find on more expensive soundbars and are happy with a modest audio upgrade, it's a great choice. If you have a little more to spend, however, the Crystal Acoustics Teevy 6 is worth considering instead.

Richard Easton



SPECIFICATIONS

SPEAKERS 2.1 • **RMS POWER OUTPUT** 60W • **DIMENSIONS** 820x490x583mm • **WEIGHT** Not disclosed • **DOCK CONNECTOR** None • **NETWORKING** Bluetooth (SBC, aptX) • **WARRANTY** One year RTB • **DETAILS** www.evolveaudio.co.uk • **PART CODE** SB-2501

Wide enough for your **best ideas** with panoramic UltraWide screen



Expand your experience with this panoramic 34" (86 cm) UltraWide Philips display. See the big picture with all the details with AH-IPS and QHD 3440 x 1440 resolution. Multitask like never before with multiple applications at once.



BDM3470UP
BDM3270UP

MISCO Systemax

ebuyer.com

BT Business Direct

PHILIPS

MULTIROOM SPEAKER

RAUMFELD One S

COMPUTER
SHOPPER

★★★★★

RECOMMENDED £200 inc VAT •

From www.raumfeld.com/uk

VERDICT

The One S multiroom speaker packs a surprising punch for such a compact set

RAUMFELD'S STEREO CUBES sounded fantastic when we tested them earlier this year (see *Reviews, Shopper 329*), but while their boxy design was certainly eye-catching, it wouldn't necessarily suit all rooms. The need to connect the speakers with a cable was another stumbling block, but Raumfeld has remedied these problems with the One S.

Available individually for £200 or as a pair for £350, each One S speaker offers true wireless connectivity for cable-free stereo pairing. They come in black or white, like the Stereo Cubes, so you can match the speaker to your décor, although both use the same black cloth grilles to protect the drivers.

The shallow rectangular shape makes each One S considerably more compact than the Stereo Cubes, and the use of silicone-coated buttons provides resistance to humidity, making it a great choice for use in the kitchen. You'll also need to fit a rubber cover to protect the Ethernet and USB ports on the rear. The latter doubles as a convenient smartphone charging point as well as enabling you to play music stored on a flash drive. Unfortunately, the One S lacks any auxiliary inputs, whereas the Stereo Cubes had RCA jacks. If you have a pair of Stereo Cubes, you can connect your analogue source to them and broadcast the audio to any other Raumfeld speaker in your setup.

BUTTON DOWN

It might look decidedly minimal, but the One S puts its limited number of buttons to good use. The four shortcut buttons on the top can be configured through the Raumfeld iOS and Android apps to play your favourite albums, playlists or internet radio stations instantly. The two white status LEDs on the front glow at an eye-searing brightness, so we were pleased to find that we could disable them through the app too.

You don't need to use a cable to connect the One S to your network – each speaker

comes with integrated 802.11n Wi-Fi. However, not only do the speakers lack support for the faster 802.11ac standard, but you're also limited to the 2.4GHz band. The only saving grace is that you don't need a separate wireless hub as you did with older Sonos systems. Raumfeld's optional Expand box creates a dedicated wireless network, but we never found any reason to use it; high-resolution tracks played perfectly from a NAS when connected over 2.4GHz 802.11n Wi-Fi.

A straightforward in-app tutorial walks you through the setup process. Sharing wireless security settings with each speaker took only a few minutes. The app itself has a nice, clean design that complements the design of the speakers. Navigating between services is simple – Tidal, Napster and TuneIn internet radio are all supported, but you can't use Spotify Connect on more than one speaker at the same time unless you run two One S units in stereo mode. Support for online services is one area where Raumfeld lags behind rivals such as Sonos, which supports many more, including Google Play Music and Deezer.

As well as streaming from the internet, you can play music from any network-connected smartphone, tablet or computer, as well as tracks stored on NAS devices. The speakers support a multitude of formats, including WAV, FLAC, OGG and MP3, with bit rates up to 192kHz/24-bit, so anyone with a collection of high-resolution music files will be able to listen to their tracks.



The sound quality was impressive for the small size of the speaker, although we shouldn't be surprised when much of what made us fans of the Stereo Cubes has been shrunk to fit in a smaller package. Like its bigger brothers, each One S uses a two-way coaxial system based around a 90mm mid-range driver, 25mm tweeter and two woofers.

Our test tracks sounded detailed, with delicate mids and treble. Bass had a respectable presence but we expected a little more from the lower frequencies. Jazz tracks made for delightful listening, and the speakers had enough impact to make electronic music sound lively and energetic.

NO LEADS

According to Raumfeld, the Stereo Cubes were connected with physical cables to minimise latency between the speakers, but we couldn't detect any perceptible delay between two One S speakers when paired wirelessly in stereo. This makes them a versatile way to open up the sound stage compared with listening to a single speaker.

The One S is a great compact speaker with an air of class and refinement about it that's also reflected in its sound quality. It sounds excellent when used solo, but the wireless stereo pairing really expands the sound stage and is far more convenient than the tethered Stereo Cubes. The fact that it costs slightly less to buy two One S speakers is a bonus.

While we prefer the design and sound quality of the One S over that of the Sonos Play:1, its nearest equivalent, the Play:1 has a slight edge for the quality of its app and its streaming service support. If you already have a Raumfeld setup, however, the One S is an excellent addition for a kitchen or small room.

Richard Easton



SPECIFICATIONS

SPEAKERS 4 • **RMS POWER OUTPUT** 30W • **DOCK CONNECTOR** None • **NETWORKING** 802.11n Wi-Fi • **DIMENSIONS** 180x110x130mm • **WEIGHT** 1.4kg • **STREAMING FORMATS** PnP, Mesh Network • **WARRANTY** One year RTB • **DETAILS** www.raumfeld.com/uk • **PART CODE** One S

AOC



Q2577PWQ

Cutting-edge features, stylish good looks

The new Quad HD panel ensures that users can enjoy a full view of a website at a single glance without image distortion. IPS technology is one of the highest performing panel technologies currently available for displays. This way, AOC makes sure users will greatly benefit from high accuracy in colour, contrast and wide viewing angles. In order to give users a variety of options for connecting different input sources, the AOC Q2577PWQ comes with DisplayPort, HDMI, DVI and VGA. Also comes with a feature that ensures a zero-flickering viewing experience.

New 32-inch size available from July 2015

www.aoc-europe.com

ebuyer.com

OVERCLOCKERSUK

[SCAN
computers](http://SCANcomputers)

[ariaPC
TECHNOLOGY](http://ariaPC)

4G ACTION CAMERA

EE 4GEE Action Cam



£300 inc VAT • From www.ee.co.uk

VERDICT

An overpriced, clunky, live-streaming action camera with dire image quality

THE ABILITY TO broadcast your high-octane activities live to an audience is the selling point behind EE's first attempt at an action camera. The 4GEE Action Cam has a built-in 4G data SIM to get you connected and broadcasting no matter where you are, and is available with or without a 24-month contract. Without a contract, it costs £300 and includes 2GB of data for the first 30 days. With the contract, you pay £50 up front and then £15 a month for 2GB of data.

Apart from its connectivity, little deviates from the design of a typical action cam. It's rectangular, with a small LCD on top for status information, as well as a set of function buttons in the familiar EE colour scheme. It's deeper and chunkier than most GoPro models, and is considerably heavier too. Sealing it into the bundled waterproof case adds significantly to the bulk, although a lightweight frame is also available.

Unfortunately, you don't get any mounts in the box – not even the adhesive type we see with the cheapest action cameras, which just feels miserly. Instead, a GoPro mount adaptor is included, so you can at least choose from the many mounting options available for GoPros at an additional expense.

WRIST ASSESSMENT

The 4GEE Action Cam almost justifies its lack of mounts by including a remote viewfinder watch. Like the Sony HDR-AZ1, the 4GEE Action Cam's remote watch provides a live view of the camera's sensor, circumventing the lack of a screen on the camera itself, and



lets you trigger recordings remotely. The screen has a relatively low resolution but is bright enough for outdoor use.

EE has chosen a distinctly more watch-like design for its remote, although it's big and chunky like a 1990s G-Shock watch. The buttons are fiddly, and it's easy to forget which button performs which function. The camera often needed re-pairing with the watch between sessions, but at least the delay between the live view and what was being captured by the sensor was minimal. You can also navigate menus and change a few major settings using buttons on the camera. The interface is basic but is at least easy to use.

The 4GEE Action Cam can record at 1080p/30fps, 720p/60fps or 480p/120fps for slow-motion footage, or shoot 13-megapixel stills. This is a little disappointing when other, similarly priced action cameras such as the Sony HDR-AZ1 and GoPro Hero4 Silver shoot 1080p at 60fps. When broadcasting, you're limited to 720p to save on bandwidth.

Astonishingly, live streaming was one of the 4GEE Action Cam's most disappointing aspects. EE forces you to use the Skeegle platform – a separate service that you'll need to register with using a Facebook account. Anyone who wants to watch your broadcasts will also need to set up an account, and you'll

need to add each other into friend circles. This is far clunkier than other live streaming services, many of which are supported by other action cameras, although admittedly they require a Wi-Fi connection to another device in order to broadcast.

Streaming quality depends on the strength of your 4G coverage, but in our experience the types of location best suited to extreme sports aren't well known for their 4G coverage. Live streaming still works over slower 3G connections, but quality suffers.

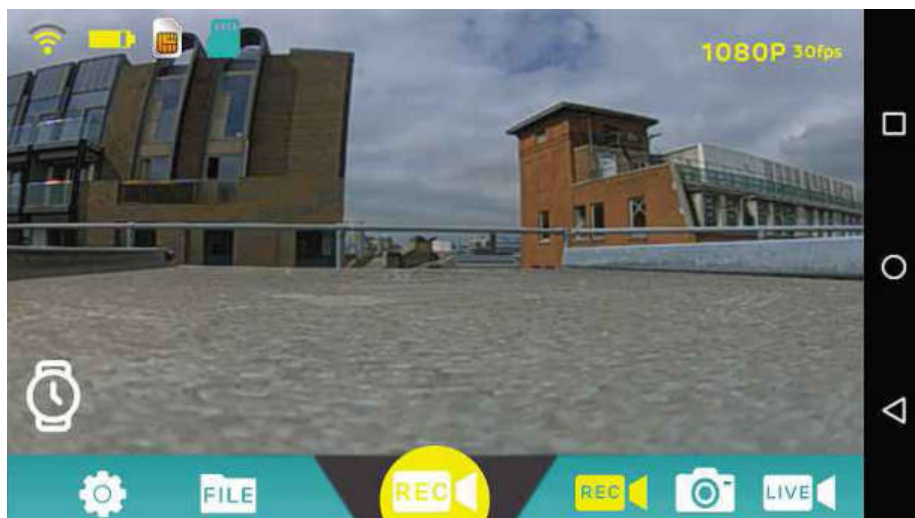
Even locally stored clips were disappointing. Despite testing it outside in good light, the 4GEE Action Cam provided washed out colours with lots of compression artefacts. Images were soft, with chromatic aberration around the edges of subjects, and there was lots of judder when panning. Sound was very tinny and lacked detail. We expect much better from an action camera as expensive as this.

HARD CELL

Battery life was the only highlight. It lasted three-and-a-half hours when recording 1080p video at 30fps and two hours while broadcasting 720p video, which is impressive. The battery is replaceable, too, which is useful if you want to swap out while on the move.

Aside from long battery life, which is the best we've seen from an action camera, there's not a lot to be impressed by here. The 4GEE Action Cam is bulky, and the lack of any mounting accessories is a travesty. This combined with the need to use Skeegle and the high cost of ownership if you use 4G makes the 4GEE Action Cam difficult to recommend. We'd rather buy the cheaper Sony HDR-AZ1 and sacrifice live streaming, or stretch a little further for a GoPro Hero4.

Richard Easton



↑ The 4GEE companion app for iOS and Android gives you easy access to settings, including live streaming

SPECIFICATIONS

SENSOR CMOS (size not disclosed) • **SENSOR PIXELS** 13,000,000 • **MAX RECORDING RESOLUTION** 1080p (30fps)
AV CONNECTIONS None • **DIMENSIONS** 43x59x105mm •
WEIGHT 128g • **WARRANTY** One year RTB •
DETAILS www.ee.co.uk • **PART CODE** 4GEE Action Cam

Emsisoft Anti-Malware

Your ultimate weapon against all Internet threats

- Dual virus - & malware scanner
- Surf- and phishing-protection
- Secure banking, behaviour blocker, PUP removal and more!

Emsisoft Internet Security

Awarded protection for your computer + Firewall



Malware removal guaranteed.

Or your money back.

Get your **FREE** 30 day trial now!



802.11ac WI-FI RANGE EXTENDER

NETGEAR Nighthawk EX7000

COMPUTER
SHOPPER

★★★★★

RECOMMENDED

£95 inc VAT • From www.pcworld.co.uk

VERDICT

Incredible speeds if you have compatible hardware, but overkill for many

NETGEAR'S EX7000 IS designed to extend your wireless network or, in access point mode, add fast dual-band 802.11ac wireless to your current network. It's rated for AC1900 speeds, which means a theoretical maximum of 1,300Mbit/s on the 5GHz band and up to 600Mbit/s on the 2.4GHz band, but only if you connect it to a router and wireless adapters capable of similar speeds.

In its default configuration, the EX7000 can be placed anywhere within range of your Wi-Fi router and used to extend its signal. The five Gigabit Ethernet ports on the extender's rear also let you hook up multiple games consoles, PCs or set-top boxes to the wireless network, even if they lack integrated Wi-Fi,

SPECIFICATIONS

WI-FI STANDARD 802.11ac • STATED SPEED 1,900Mbit/s •
USB PORTS 1x USB3 • WALL MOUNTABLE No •
WARRANTY Two years RTB • PART CODE
90IG01A0-BU9000

and the USB3 port on the front can be used to add a USB flash drive as a network share.

Setup isn't quite as simple as with other range extenders, but otherwise the web interface is straightforward. It automatically appends suffixes to your existing Wi-Fi networks to make it easy to tell which is your router's network and which is the extender's.

Once you're set up, you can unplug the extender and move it away from your router to help wipe out any Wi-Fi blackspots. The web page main menu displays signal strength for both bands, letting you know when you've moved too far away. Netgear's excellent Wi-Fi analytics app gives you a real-time indication of signal strength, and also lets you identify crowded Wi-Fi channels. These features aren't included in the router firmware, though.

The EX7000 is one of the fastest extenders around when paired with an 802.11ac router capable of matching its wireless speeds. We extended the signal of a Netgear Nighthawk

X4 R7500 router, and when connected to the extender we saw 181Mbit/s at a distance of 10m. This only dropped to 167Mbit/s at 25m, a big improvement over the 68.2Mbit/s we saw when connected directly to the router.

You can also use the EX7000 as a wireless access point, to add faster Wi-Fi to your existing network. In this mode we saw a fantastic 326Mbit/s at 5m and 302Mbit/s at 10m, while 149Mbit/s at 25m is still perfectly usable for streaming video.

If you want to extend the range of a super-fast 802.11ac router, or to give your current router a serious Wi-Fi boost, Netgear's Nighthawk EX7000 is a good buy. Bear in mind you'll need high-specification 802.11ac kit to make the most of it; if you're mainly planning to eliminate black spots to use with mobile phones and tablets, you're better off with the slower BT Dual-Band Wi-Fi Extender 1200 (Shopper 330), which is much cheaper.

Tom Morgan



Y-CAM

IT'S AS EASY AS CLOSING THE DOOR

Motion Activated Cloud Security Camera Solution

"It has saved me thousands of pounds in losses"

As seen on one

Andy Price
Managing Director
of ITSS Recruitment

FREE APPS



Y-cam
HomeMonitor HD

Was
~~£149.99~~

Now
£104.99



1 MILLION
UPLOADS PER DAY

★★★★★

9/10
RECOMMEND US*



8 YEARS
EST. 2007



FREE
7 DAY CLOUD STORAGE

NO MONTHLY FEE*

LIMITED TIME
SPECIAL OFFER
30% OFF

Y-cam
HomeMonitor
HD Pro

Was
~~£199.99~~

Now
£139.99



Find us on social
@ycamsolutions

www.homemonitor.me
www.y-cam.com

*Y-cam HomeMonitor customer survey March 2015, percentage of customers that said they would recommend Y-cam HomeMonitor, 6+ on a scale 1-10

Offer only Available at Y-cam.com until 1st November 2015
DISCOUNT CODE: SECURE1221

BT Ultra HD YouView

COMPUTER SHOPPER

★★★★★

RECOMMENDED

£15 per month inc VAT • From shop.bt.com

VERDICT

Ultra HD makes Full HD look old hat and it's great to have a live 4K channel, but there's relatively little content at the moment

4K ULTRA HD TVs have been around for a while, but the lack of content has been more than a little disappointing. Things are starting to change, though, with Netflix and Amazon delivering on-demand programming and BT stepping into the ring with the UK's first live Ultra HD channel: BT Sport Ultra HD.

The new channel is streamed over the internet to a YouView set-top box – in this case, the Humax DTR-T4000. The benefit of the YouView system is that internet channels appear in the guide alongside broadcast channels, and you can even record them. It's this blurring of traditional and internet content that makes YouView a real winner.

The DTR-T4000 is practically identical to the current Full HD YouView+ box, which remains on sale. The 1TB hard disk is enough for around 600 hours of SD content, 250 hours of HD and 60 hours of Ultra HD. Aside from a few cosmetic differences, the big change is the HDMI 2.0 output on the rear.

NEED FOR SPEED

Not all HDMI inputs support 4K at over 30 frames per second, so it's worth checking the BT site for compatibility with your TV. The box also has to be connected to the internet. Given the bandwidth that you'll need for Ultra HD, a direct Ethernet connection to your router is best; HomePlug adaptors should work, but you'll need 500Mbit/s or faster adaptors to ensure there's enough bandwidth.

On top of needing BT Infinity Option 1 or Option 2 broadband, BT Ultra HD costs £15 a month. Existing customers have to pay £49

for the box, but new customers get it for free. There's also a £44 installation fee for those not confident in setting up the box.

As with other YouView boxes, the DTR-T4000 is incredibly slow to start up when set to High Eco mode, which is designed to save power; you can switch it to Low mode, but we found it got incredibly hot and its fans whirled noisily even in standby. We love the EPG, which lets you watch on-demand shows that you've missed across the main terrestrial channels. You also get Sky Now TV and BT's

BT Sport is delivered in glorious Ultra HD at double the frame rate of traditional TV. The short summary is: wow

own app, but Netflix is a surprising omission. The issue is that Netflix has yet to certify the new box, although the service should arrive later this year, including its Ultra HD streams.

SPORTING CHANCE

The primary purpose of this box is to deliver BT Sport in glorious Ultra HD, 3,840x2,160 at 50fps – that's double the frame rate of traditional TV. The short summary is: wow. The extra resolution makes a huge difference, with every single bit of detail present. The improvement was clearly visible in a football match: grass was full of texture, the ball was

easier to see and the players looked clearer. Switching back to HD truly showed how much better 4K is; the older channel looked softer in comparison. Sport really benefits from the 50fps footage, too, as fast-paced action is easier to follow and considerably less jerky.

Delivering this content requires a fairly hefty broadband connection. Streams use around 29Mbit/s of your total bandwidth – no wonder this service is only available to Infinity customers. Even Infinity customers on Option 1 (38Mbit/s) that live any distance from their

fibre cabinet might find their connections unable to cope, or at the very least their web-browsing speeds might be seriously affected while streaming Ultra HD.

Our one issue is that there's currently very little content on the Ultra HD channel, outside of the Premiership, Champions League, FA Cup, Premiership Rugby and MotoGP. Much of the time, the Ultra HD channel is just a set of adverts on a loop. Dive into the BT app via YouView and there are a few bits of Ultra HD content to watch, but it's essentially demo footage rather than movies and TV shows.

It's a shame more Ultra HD content isn't available, but sports junkies – primarily football fans – won't get better quality anywhere else. Given the number of matches you'll get this year, the £15 monthly fee is competitive.

Sky is already deep in the planning stages for its own rival platform, and knowing Sky, its launch is bound to be bigger and with more content. Until it arrives, however, BT has ushered in a new era of TV with its Ultra HD service, doing something that you might not have thought was possible just a few weeks ago: making HD channels look bad.

David Ludlow



SPECIFICATIONS

TUNERS 2x Freeview HD (YouView) • **DIMENSIONS** 273x152x43mm • **NETWORKING** Gigabit Ethernet • **INTERNAL DISK CAPACITY** 1TB • **WARRANTY** One year RTB • **DETAILS** www.productsandservices.bt.com • **PART CODE** BT Ultra HD

OFFICE INKJET MFP

CANON Maxify MB5350



£180 inc VAT • From www.printerland.co.uk

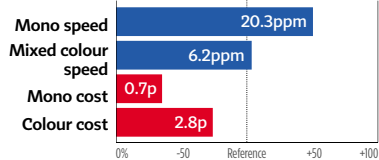
VERDICT

The most convincing Maxify we've reviewed, but it's still not quite a winner

DESPITE ITS VERY reasonable price, the Maxify MB5350 is stuffed full of useful features: there are two 250-sheet paper trays, wired and wireless networking, a colour touchscreen, and duplex printing, scanning, faxing and copying.

SPECIFICATIONS

TECHNOLOGY Thermal inkjet • **MAX PRINT RESOLUTION** 600x1,200dpi • **MAX OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH)** 1,200x1,200dpi (24-bit) • **DIMENSIONS** 351x463x394mm • **WEIGHT** 13.1kg • **MAX PAPER SIZE** A4/legal • **WARRANTY** One year onsite • **DETAILS** www.canon.co.uk • **PART CODE** 9492B008AA



See page 72 for performance details

At the top is a touchscreen, a few function buttons and status lights. The screen isn't responsive, though, and transitions between menu items are often needlessly slow due to chuggy fade effects and animations.

The main menu includes a prominent Cloud option, behind which lies support for services such as Dropbox, Google Drive and Evernote. However, the Cloud submenu was prone to lag. Cloud support is quite impressive: you can either scan to or print from files stored online, for example.

The MB5350 arrives with a generous 1,000-page black cartridge and colour tanks good for 700 pages each. When these are exhausted you can replace them with a 2,500-sheet black tank and colour supplies averaging 1,500 pages each, for a cost per colour page of 2.8p. That's pretty good, and a 0.7p per page cost for black prints is also very impressive.

The MB5350 delivered our 25-page mono test at a cracking 20.3ppm, and needed just 51



seconds to copy a 10-page document in black only. Colour printing was less impressive. The MB5350 managed only 6.2ppm in our 24-page colour test, and needed 1m 49s to copy a 10-page document in colour.

We wouldn't mind so much, but prints and copies suffered from desaturated, dull colours, leaving graphics looking ashen and presentations lacking impact. Pages felt damp after printing, and there was a small amount of bleed-through in duplexed graphics; and at nearly four minutes for 10 sides of colour graphics, duplex printing was slow. Scans were generally excellent, but auto-exposure didn't work as well as we'd expect, leaving our office document's white background a little blueish.

The MB5350 has plenty to recommend it, particularly if you don't print lots of colour pages. Overall, however, it misses the mark. We'd rather pay another £45 or so for Epson's WorkForce Pro WF-5620DWF, which matches or beats the MB5350 in most regards.

Simon Handby

BUDGET MFP

BROTHER MFC-J5320DW



£80 inc VAT • From www.printerland.co.uk

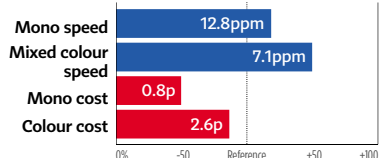
VERDICT

A cheap way to tackle any print, scan, copy or fax job a small firm might need

THE PRICE OF Brother's MFC-J5320DW prompted a double-take. For under £100 this compact inkjet MFP can print, scan, copy and fax, all controlled via a colour touchscreen. You can share it over a wired or wireless network and scan directly to an inserted USB

SPECIFICATIONS

TECHNOLOGY Piezo inkjet • **MAX PRINT RESOLUTION** 1,200x6,000dpi • **MAX OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH)** 1,200x2,400dpi (24-bit) • **DIMENSIONS** 240x490x290mm • **WEIGHT** 10.8kg • **MAX PAPER SIZE** A3 • **WARRANTY** One year RTB • **DETAILS** www.brother.co.uk • **PART CODE** MFCJ5320DWU1



See page 72 for performance details

stick, or even to a cloud-based service such as Google Drive. It has a 35-page automatic document feeder, can automatically print on both sides of each page, and as if all that wasn't enough it can even print on A3 paper.

It's understandable if it feels like money has been saved elsewhere. This isn't a pretty MFP, and its paper input tray feels particularly clattery. To load the tray with A3 paper you release a catch and extend it fully outwards, which is fiddly, while different paper sizes are loaded with different orientations, which could get confusing. The USB port is behind a flap next to an empty slot where the SD card reader would go on more expensive models.

While the 12.8ppm text speed isn't that great, 7.1ppm in our colour graphics test is quick for an inkjet at this price. It took only two-and-a-half minutes to duplex 10 sides of graphics on to five pages, while copying a 10-page document took only 66 seconds in black, or 83 seconds in colour. Scans were



quick, with a preview taking 10 seconds, and a 300dpi A4 scan needing only 12 seconds.

There's more good news when it comes to running costs. The MFC-J5320DW comes with ink cartridges rated for a reasonable 550 pages each, and you can replace them with XL items good for 2,400 black pages or 1,200 pages in each colour. Using these, colour costs work out at just 2.6p per page, while black prints cost just 0.8p per page.

Print quality certainly wasn't bad on plain paper, with bold text and reasonably bright colours in graphics. Our scan tests revealed a slightly drab colour bias, and poor preservation of detail from among dark regions, but the results were good enough for general office work. This is far from the best MFP we've tested, but with its wealth of features, cheap price and low running costs we'd recommend it where value takes precedence over quality.

Simon Handby

HOME OFFICE MFP

HP Officejet Pro 6830



£86 inc VAT • From www.amazon.co.uk

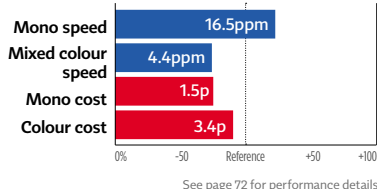
VERDICT

It has some strengths, but they are offset by too many frustrations

IT MAY BE a 'Pro' printer, but the 6830 is in fact priced and specified for the home office market. This compact inkjet MFP includes wired and wireless networking, a colour touchscreen, and automatic duplex printing. A 35-page automatic document feeder takes care of multi-page faxes or photocopies.

SPECIFICATIONS

TECHNOLOGY Thermal inkjet • **MAX PRINT RESOLUTION** 600x1,200dpi • **MAX OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH)** 1,200x1,200dpi (24-bit) • **DIMENSIONS** 224x462x388mm • **WEIGHT** 8kg • **MAX PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** www.hp.co.uk • **PART CODE** E3E02A



We often criticise HP's TWAIN interface for its lack of advanced options or free selection of common scan resolutions. Here things are worse, as the scanner is very slow: tested over an Ethernet connection it took 1m 23s to scan a 6x4in photo at 600dpi. At 1,200dpi it needed more than five minutes, one of the slowest results we've timed. High-resolution scans also appeared to have been processed, leaving them looking artificial.

We've no complaints about the quality of prints, which had sharp black text and bright colours. There was a hint of bleed-through with duplex prints, but this isn't uncommon when using 80gsm paper on an inkjet.

If you stick to the XL versions of HP's 934 black cartridge and 935 colour cartridges, running costs work out at a reasonable 3.4p per A4 colour page. Overall, however, the Officejet Pro 6830 just has too many frustrations. Brother's MFC-J5320DW is cheaper and has lower running costs.

Simon Handby

OFFICE MFP

EPSON WorkForce Pro WF-5690DWF



£342 inc VAT • From www.printerland.co.uk

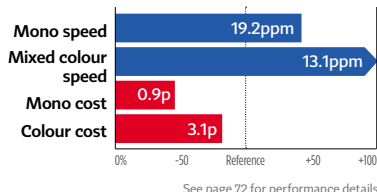
VERDICT

The WorkForce Pro WF-5690DWF is a great office MFP, but at this price it isn't the one we'd choose

EPSON'S WORKFORCE PRO WF-5690DWF is an inkjet MFP for a busy small office. It's well specified, with Gigabit Ethernet and wireless networking fitted as standard, along with a huge 10.9cm colour touchscreen. Not only can it print automatically on both sides

SPECIFICATIONS

TECHNOLOGY Piezo inkjet • **MAX PRINT RESOLUTION** 1,200x4,800dpi • **MAX OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH)** 1,200x2,400dpi • **DIMENSIONS** 342x461x422mm • **WEIGHT** 14.3kg • **MAX PAPER SIZE** A4/legal • **WARRANTY** Three years onsite swap • **DETAILS** www.epson.co.uk • **PART CODE** C11CD14301BY



of a sheet of paper, but its 35-page automatic document feeder lets you make a double-sided copy or fax of a double-sided original without having to feed the sheets manually.

Epson's driver software is easy to use, but we're not so enamoured with the printer's touchscreen. Although the picture is clear it isn't always responsive, and the menu system is more complex than strictly necessary.

When it comes to speed, there's not much between this MFP and a laser printer. The WF-5690DWF delivered our 25-page letter test at 19.2ppm, and managed 13.1ppm on our graphics-heavy colour test. Duplexing 10 colour sides on to five pages took 99 seconds. It was particularly quick in our scan tests, completing an A4 preview in just six seconds, capturing a page at 300dpi in 14 seconds, and needing only 37 seconds to scan a 6x4in colour photo at 1,200dpi.

Scan, print and copy quality is uniformly good. While black text isn't quite laser-sharp,

it's as good as we've seen from an inkjet. Colour graphics had more impact on plain paper than most rivals' efforts, although there was just a trace of bleed-through with duplex prints on 80gsm paper.

This printer has a cheap 'maintenance box' rated for 50,000 pages, and its consumables are available in several sizes up to 4,000-page 'XXL' items. Colour costs of 3.1p per A4 page are cheaper than any directly competing laser, but ink prices have been falling, and the running costs of the WorkForce range are no longer exceptional among office inkjets.

With low running costs and great all-round performance, this MFP makes more sense than an equivalent colour laser, but it's too expensive. If you can do without PostScript 3, the WF-5620DWF is much cheaper. If you do need PostScript 3, HP's Officejet Pro X476dw is even quicker to print and is cheaper to run.

Simon Handby

NAS WITH TWO HARD DISKS

WESTERN DIGITAL My Cloud EX2100

COMPUTER
SHOPPER

★★★★★

RECOMMENDED

£437 inc VAT • From www.dabs.com

VERDICT

Excellent file transfer speeds and easy setup, but WD still lags behind others when it comes to features

MOST NAS DEVICES are just empty shells; useless until you add a hard disk or two. Not so Western Digital's My Cloud EX2100: it comes pre-fitted with a pair of WD Red hard disks, designed specifically for NAS devices, so is ready to go right out of the box.

The EX2100 is a two-bay NAS, with two 3½in drive bays at the front, filled with two 4TB hard disks. The black metal enclosure is

utilitarian, though the glossy front panel and LED power button add a little flair. There's a USB3 port on the front and a second on the back, which can be used to add external hard disks or flash drives to your network shares.

There are also two Gigabit Ethernet ports, which can be used for redundancy if your primary network goes down. They can also be used for daisy-chaining multiple NAS devices together. These are business features, but home users haven't been forgotten: the EX2100 also supports DLNA and UPnP media sharing. You won't want to keep this NAS next to your TV, though: the EX2100 is louder than most.

Powered by a dual-core 1.3GHz Marvell Armada 385 processor and 1GB of DDR3 memory, the EX2100 is roughly on a par with other mainstream NAS devices in terms of hardware. Read and write speeds were consistent, with 110.1MB/s write and 112.5MB/s read speeds in the 2.5GB huge files test, and 105MB/s write and 109.4MB/s read speeds in the large files test. Our punishing small files test takes significantly longer, but

74.2MB/s writes and 51.2MB/s read speeds are still very respectable.

Western Digital still lags behind its rivals with its web interface. The main screen gives a simple overview of remaining capacity, disk health and CPU activity, but aside from user management, creating new folder shares and setting up backups, there's just not a lot here. Smartphone apps for remote access are a welcome inclusion, and WD's excellent backup software is useful, but otherwise you'll have to rely on third-party apps to add features such as remote file hosting and web servers.

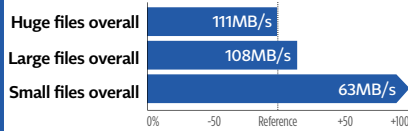
At £437, the My Cloud EX2100 is roughly on a par with our current favourite NAS, Synology's DS215J, and a pair of 4TB WD Red hard disks. If you don't mind setting up the NAS yourself, the Synology NAS is far more comprehensive; it may not be quite as quick, but it's overflowing with features. The EX2100 is fine if you're after simple network storage, but most people will benefit from Synology's more advanced features.

Tom Morgan



SPECIFICATIONS

CAPACITY 8TB • **3½in HARD DISK BAYS (FREE)** 2 (0) • **NETWORKING** 1x 10/100/1,000 Ethernet • **DLNA MEDIA SERVER** Yes • **PRINT SERVER** No • **DIMENSIONS** 108x216x147mm • **WEIGHT** 2.1kg • **WARRANTY** Two years RTB • **DETAILS** www.wdc.com • **PART CODE** WDBWAZ0080JBK-EESN



See page 72 for performance details

PORTABLE HARD DISK

TOSHIBA Canvio Connect II 2TB

COMPUTER
SHOPPER

★★★★★

BEST BUY

£74 inc VAT • From www.ebuyer.com

VERDICT

Great performance, great software, great price – the Canvio Connect II is the whole package

TOSHIBA'S CANVIO EXTERNAL hard disks are typically no-nonsense affairs that focus on value rather than outright performance or designer looks. The Canvio Connect II is no exception, but that's not to say it's ugly: its glossy plastic finish and circular activity LED are delightfully minimal, and the whole thing is rather compact considering it houses a 2½in mechanical hard disk. With just a USB3

connector on one end and a short 45cm USB3 cable in the box, it's also incredibly simple.

In our testing, the Canvio Connect II was remarkably consistent. We expect to see some deviation when transferring small files compared to larger files, but in this case the results were similar, indicating the disk is reaching its speed limit before the USB3 interface can be saturated with data.

There were minor deviations, but with small files writing at 112.1MB/s and reading at 97.7MB/s, compared to large files writing at 112.5MB/s and reading at 103.2MB/s, you shouldn't be left waiting long to transfer data to or from the disk, regardless of file size. Our massive files typically max out mechanical hard disks, and this remained the case here, with 112.4/s write and 108.7MB/s read speeds.

Toshiba bundles backup and remote access software on the disk, with NTI Backup Now EZ for creating duplicates of your files

and Pogoplug to access those files from anywhere over the internet, as long as the PC your disk is connected to is switched on. You also get 10GB of cloud storage. We suggest avoiding Symbaloo, a third-party bookmark manager that doesn't do anything Chrome or Internet Explorer don't. The Tuxera NTFS driver for Mac is a welcome addition for OS X users, too, letting you use the disk without needing to reformat it to a Mac file system.

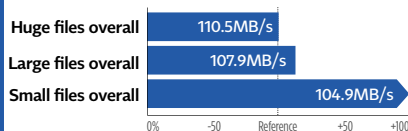
With excellent read and write speeds, comprehensive software and a reasonable price for the 2TB model reviewed here, the Canvio Connect II is a superb portable hard disk. It looks the part, regardless of the colour you opt for, and easily slips in a pocket, meaning you can always have all your files with you when you're on the move. It's well deserving of our Best Buy award.

Tom Morgan



SPECIFICATIONS

CAPACITY 2TB • **COST PER GIGABYTE** 4p • **INTERFACE** USB3 • **WARRANTY** One year RTB • **DETAILS** www.toshiba.eu • **PART CODE** HDTC820ER3CA



See page 72 for performance details

Iiyama's ULTRA SLIM **MONITOR SERIES**, PERFECT FOR MULTI MONITOR ARRANGEMENTS



xx90 ultra slim monitor line with clear and vivid image,
perfect for multi monitor arrangements.

Available in 22", 23", 24", 25" and 27" with and without height
adjustable stand.



iiyama

www.iiyama.com

MSI Z170A Gaming M5

COMPUTER
SHOPPER
RECOMMENDED£150 inc VAT • From www.scan.co.uk

VERDICT

This seriously comprehensive Skylake motherboard gives you everything you could want now – and for several years into the future

RED AND BLACK is certainly the colour scheme of choice for high-end motherboards, but while we like the matt finish of Asrock's Z170 Gaming K6+, the metallic heatsinks and silver PCI-Express ports of MSI's Z170A Gaming M5 look even better. This is the first MSI motherboard we've seen that's built for Intel's new Skylake processors and, as you would expect, it has all the high-end features you could want.

Like all Z170 motherboards, the Gaming M5 features an LGA1151 socket that's designed exclusively for 6th Generation Core processors, so you can't use it with the previous generation of Haswell chips. Two dedicated CPU fan headers near the socket should save you having to run cables across the board if you use a cooler with multiple fans, while the heatsink around the power circuitry won't get in the way of large air

The M.2 slots have been raised slightly higher than on other motherboards, leaving room for SSDs with chunky heat spreaders or stacked memory modules

coolers. The four RAM slots support up to 64GB of DDR4 memory, running at up to 3,600MHz with overclocking.

As well as its six SATA3 6Gbit/s ports, the most important storage additions for 2015 are the two M.2 expansion slots for SATA or PCI-Express SSDs and SATA Express for U.2 external disks. The M.2 slots have been raised slightly higher than on other motherboards, leaving room for SSDs with chunky heat spreaders or stacked memory modules. Installing two M.2 SSDs will disable two of the regular SATA ports, however. All the SATA ports are angled outwards rather than upwards, so it's easier to connect your cables before installing the board rather than struggling with it when mounted in a case.

We like the fact that MSI has angled the USB3 header on the right side of the board, as this chunky cable can get in the way of other components if manufacturers don't think carefully about its placement.

The black and red theme continues on the rear I/O panel, with the PS/2 port, USB3 ports and 3.5mm microphone jack receiving a splash of colour. This makes the solitary USB 3.1 port tricky to spot, however – the only difference between it and the four USB 3 ports is a slight indentation that will be impossible to see if you keep your PC under a desk. Good luck plugging in all four 3.5mm cables for a 5.1 speaker system correctly on the first try too, as they're all black rather than colour-coded.

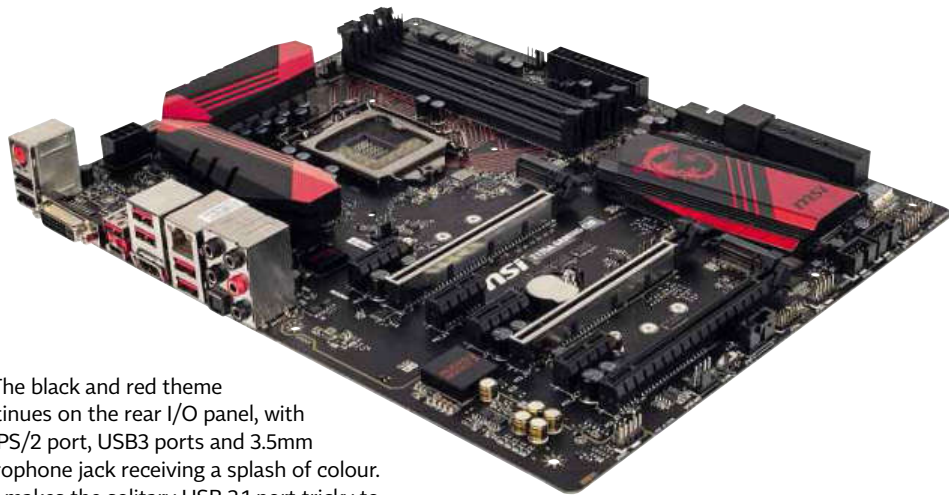
You'll also find gaming-grade Killer Networking Gigabit Ethernet, a reversible USB Type-C port and DVI and HDMI video outputs if you plan to use your processor's integrated graphics. However, with three PCI-Express 3.0 slots there's plenty of room for adding graphics cards. The top two have even been reinforced to prevent very heavy graphics

cards damaging the slots. The top slot defaults to x16 speed, but if you add a second card this drops to x8 speeds. With three cards installed in SLI, the first two will run at x8 and the third at x4 speeds.

With our reference components (an Intel Core i5-6600K, 8GB of DDR4 RAM and an AMD Radeon R7 260X graphics card) installed and running at their stock speeds, the Gaming M5 scored 121 overall in our 4K multimedia benchmarks. This puts it slightly in front of the Asus Z170-A (see page 58).

As only enthusiast-level chips are available at launch, we expect that most Skylake upgraders will add a dedicated graphics card to their system, but the Gaming M5 was still able to get a smooth 50.5fps frame rate from Dirt Showdown using the Core i5-6600K's HD Graphics 530 integrated GPU.

This motherboard performs brilliantly at stock speeds, but it was clearly built with overclocking in mind. However, with no power



buttons on the board itself, the Gaming M5 is clearly designed to spend its life inside a case rather than on a test bench. The LED POST code display can still help with troubleshooting though.

In EZ mode, MSI's UEFI BIOS is sensibly laid out and the settings are clearly labelled for anyone who isn't familiar with Skylake's new unlocked Base Clock (BCLK), but for more precise control you can press F7 to enter Advanced mode. Here you can change the CPU multiplier, BCLK, RAM timings, and numerous voltage settings.

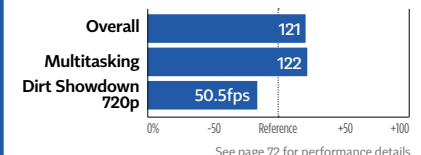
With other boards we've managed to get our Core i5-6600K up to 4.7GHz using air cooling, so we expected something similar here, but interestingly a 47x multiplier and slight voltage boost weren't enough to keep the Gaming M5 stable. That said, it still managed 4.5GHz with minimal tweaking, and produced an excellent 143 overall in our multimedia benchmarks – beating the Asus Z170-A when it was running 200MHz faster.

MSI has built arguably the most future-proof Z170 motherboard we've seen, with twin M.2 slots for thicker, stacked memory SSDs, two SATA Express ports and great overclocking performance – if not the best. A comprehensive software suite including a RAMdisk and XSplit Gamecaster software for live streaming to Twitch or YouTube add to the value, and while it costs slightly more than the Asus Z170-A, we think the extra is worth paying if you plan to use M.2 any time soon.

Tom Morgan

SPECIFICATIONS

PROCESSOR SOCKET LGA1151 • **DIMENSIONS** 303x242mm • **CHIPSET** Intel Z170 • **MEMORY SLOTS** 4 • **PCI-E x16 SLOTS** 3 • **PCI-E x1 SLOTS** 4 • **PCI SLOTS** 0 • **USB PORTS** 2x USB, 4x USB3, 2x USB 3.1 • **VIDEO** • **OUTPUTS** DVI, HDMI • **WARRANTY** Three years RTB • **DETAILS** uk.msi.com



100%

FOR YOUR WEB PROJECTS

Expertise and enthusiasm. Over 25 years of experience. 5 high-performance data centres. More than 12 million customer accounts. 8,000 specialists in 10 countries. We live for the Internet and give 100% for your web projects! This makes us the right partner for you.

~~4.99~~ **£0.99**
From per month*
excl. 20% VAT

✓ 100% Performance

- Unlimited webspace
- Unlimited websites
- Unlimited traffic
- Unlimited e-mail accounts
- **NEW: Unlimited** MySQL databases now on SSD!
- Unlimited domains

✓ 100% Availability

- **Geo-redundancy** and daily backups
- 1&1 CDN
- 1&1 SiteLock Basic
- 24/7 support

✓ 100% Flexibility

- 1&1 Click & Build Applications including WordPress and Joomla!®
- 1&1 Mobile Website Builder
- **NEW:** NetObjects Fusion® 2015 1&1 Edition



☎ 0333 336 5509



1and1.co.uk

*1&1 Unlimited from £0.99 per month. Some features listed are only available with 1&1 Unlimited Plus from £4.99 per month. 12 month contract term and 1 month billing cycle with payment in advance, then regular price applies. Prices exclude 20% VAT. Visit 1and1.co.uk for full offer details, terms and conditions. Rubik's Cube® used by permission of Rubik's Brand Ltd. 1&1 Internet Limited, Discovery House, 154 Southgate Street, Gloucester, GL1 2EX.

ASUS Z170-A

COMPUTER
SHOPPER
BEST BUY£116 inc VAT • From www.scan.co.uk

VERDICT

Asus proves once again that performance and features aren't reserved for the top end – the Z170-A is the best-value Skylake motherboard we've seen

ASUS HAD A comprehensive range of Z170 motherboards ready in time for Intel's official Skylake launch, catering equally for gamers and overclockers. The Z170-A we review here is arguably the most mainstream board we've seen, but it's still fully featured, with an appealing grey and white colour scheme that should complement almost any PC build.

It might not have the flashing LEDs, bright colours or even a POST code display for troubleshooting, but the Z170-A has everything you need to get a Skylake PC up and running, including support for four sticks of DDR4 RAM running at up to 3,400MHz. The dedicated water pump fan header is a welcome addition and, with the two CPU fan headers and four chassis fan headers, brings the total up to seven. Unless you have a gargantuan case, you won't need to buy an external fan controller or add extension cables

use the interface as two SATA3 ports instead, raising the total number to six. That's not the most we've seen on a motherboard, but it's more than enough for building a PC with multiple hard disks, SSDs and optical drives.

Only the top PCI-Express x16 slot operates at full speed – the second and third slots drop to x8 speeds if you install two graphics cards. The three PCI-E x1 slots are a welcome addition as they enable you to add wireless or other expansion cards, and this is one of the only Z170 motherboards we've seen with a legacy PCI slot for any older card you might have.

Compared with other Z170 motherboards we've seen, the Z170-A is a little stingy in its provision of USB ports, with only two regular USB ports, two USB3 ports and two USB 3.1 ports on the back of the board. One of the latter pair uses the reversible Type-C

processor's integrated graphics, the Z170-A still managed to produce a stable 41.2fps frame rate in Dirt Showdown when using the i5-6600K's HD Graphics 530 GPU.

The Core i5-6600K processor was made for overclocking, and thankfully the Z170-A is well-equipped to get the most out of it. The BIOS is brimming with settings, although most are hidden in the Advanced menu. The Asus EZ overclocking utility, which is on the main screen, erred on the side of caution, boosting our CPU by only 20% because we were using a tower cooler rather than water-cooling.

Instead we resorted to manual overclocking, bumping the multiplier up to 47 and boosting the CPU voltage slightly to get a stable 4.7GHz (up from 3.9GHz), which helped the multimedia benchmark score jump to 130 overall. This wasn't quite as high as we've managed on other motherboards using the same components, but with a multitude of BCLK (Base Clock), voltage settings and other variables to tweak, there's plenty of scope for getting more from your components if you're prepared to move beyond the CPU multiplier.

It's clear that Asus knows exactly how to get everything power users want on to a motherboard without going wild with flashy extras that add unnecessarily to the price. The Z170-A is the cheapest Skylake motherboard we've seen so far by around £30, but it has almost all the connectivity of its more expensive rivals and overclocks almost as well if you adjust settings manually rather than relying on the cautious automatic presets. If you want all-out performance or lots of extras, the MSI Z170A Gaming M5 (see p56) is probably better at around £35 more, but for everyone else this is the Skylake board to buy.

Tom Morgan

It's clear that Asus knows exactly how to get everything power users want on to a motherboard without going wild

to your power supply. The I/O shield won't obscure big tower coolers either, and left plenty of room around the LGA1151 socket for our BeQuiet! Dark Rock Pro 3 twin fan cooler.

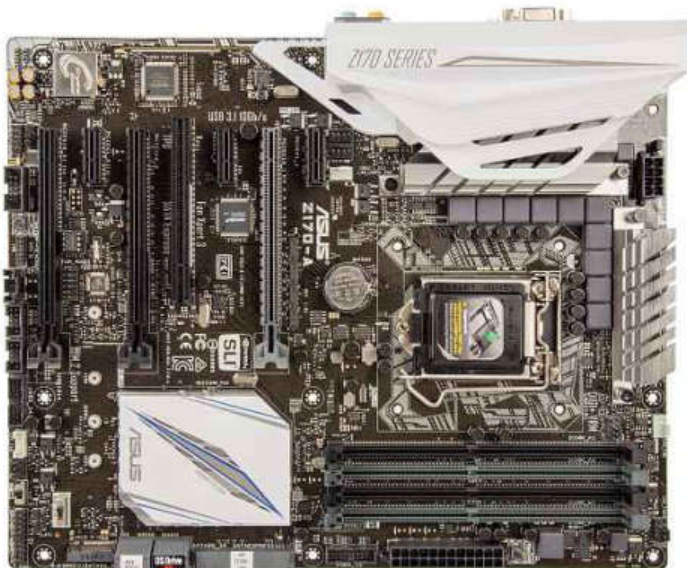
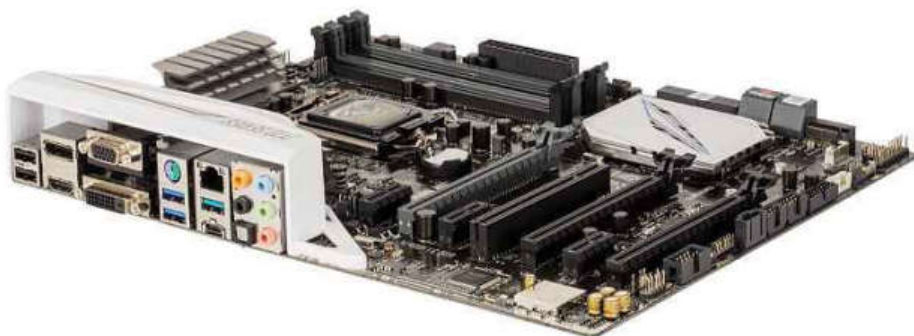
The Z170-A is well-equipped for modern storage devices, with a PCI-Express-ready M.2 slot and SATA Express for 2½in SSDs. If you don't have any SATA Express devices, you can

connector. If your case has the right ports, however, you can more than make up for this, as the board also has two USB3 headers on the bottom and right edges.

The rear I/O panel provides DVI, VGA, HDMI and DisplayPort video outputs in case you want to use your processor's integrated graphics, although only three displays are supported simultaneously. You also get a legacy PS/2 port for a keyboard, Gigabit Ethernet, five 3.5mm audio jacks for analogue 7.1 and a digital optical output.

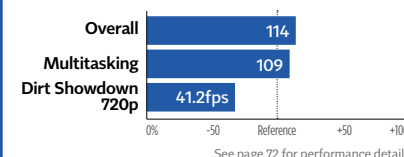
When we tested the Z170-A with an Intel Core i5-6600K processor running at its stock 3.9GHz Turbo speed, 8GB of Corsair DDR4 RAM and an AMD Radeon R7 260X graphics card, it managed a score of 114 overall in our 4K multimedia benchmarks. This puts it roughly in line with the other Skylake motherboards we've tested so far.

While we wouldn't expect many people who upgrade to Skylake to stick with their



SPECIFICATIONS

PROCESSOR SOCKET LGA1151 • DIMENSIONS 302x244mm • CHIPSET Z170 • MEMORY SLOTS 4 • PCI-E x16 SLOTS 3 • PCI-E x1 SLOTS 3 • PCI SLOTS 1 • USB PORTS 2x USB, 2x USB3, 2x USB 3.1 • VIDEO OUTPUTS DVI, VGA, HDMI, DisplayPort • WARRANTY Three years RTB • DETAILS www.asus.co.uk





THE INTERNET OF EVERYTHING
presents

the last queue

We're building the Internet of Everything for business. With UCS Server solutions providing data centre performance everywhere, mobile applications and analytics keep queues short and customers happy. Let's confine queueing to yesterday.

See how at cisco.co.uk/thelastqueue



TOMORROW starts here.

Cisco UCS with
Intel® Xeon®
processors



OPERATING SYSTEM

MICROSOFT Windows 10

COMPUTER SHOPPER
BEST BUY



Free for Windows 7 & 8 users • From www.microsoft.com

VERDICT

Microsoft has listened, and Windows 10 banishes the demons of Windows 8. More importantly, it's a great OS in its own right

WINDOWS 10 IS a huge change in strategy for Microsoft and a huge boon for PC users. Anyone who has a relatively modern Windows 7 or 8 PC can update for free, which means that for the first time since Windows XP's heyday around 10 years ago, there's no excuse not to be using the most modern and up-to-date version of Microsoft's current operating system. This in turn should lead to more people using the latest versions of apps, better security support and a consistent experience across multiple devices.

You can install Windows 10 on your PC, laptop, tablet or any hybrid device right now, but it's coming to Windows Phone 8 handsets shortly, and even the Xbox One is getting in on the act. This shared code base will allow developers to roll out apps more easily across all platforms at once, so a new version of Netflix could arrive on all devices simultaneously but with minor tweaks to account for the screen size and input device.

Installing is simple and we found the results to be largely stress free, with the latest build proving stable across multiple devices in our tests. We have a few niggles, of course, but nothing major and none that would put us off upgrading.

FIRM FOUNDATIONS

It's not really a big surprise that Windows 10 runs well, as a lot of Windows 8 is still there beneath the new interface. The outgoing operating system may have been unpopular for many reasons but it's been technically

sound for some time. This also means that compatibility shouldn't be a problem – we had no trouble running older programmes or connecting hardware, although it's worth checking that drivers are available for older devices such as printers before upgrading.

Windows is still ostensibly a desktop OS rather than a cloud-based system like Chrome OS. Such distinctions are no longer clear cut, though, and Windows 10 is heavily integrated with Microsoft's cloud services, including OneDrive. This is installed by default, so you can easily sync and back up files to the cloud. Then there's Office 365, which provides browser-based and (optionally) desktop Office apps for a monthly fee.

Windows 10 will be largely familiar to anyone who's used a previous version. The Start menu returns for launching your applications, along with the Taskbar for keeping track of what you've got open. The Start menu now incorporates a section of live tiles for various apps, but if you don't like them you can remove them entirely: just right-click each one and choose the unpin option. There are lots of fancy new ways to navigate the desktop but they are entirely optional. In short, if you were annoyed that Windows ever changed from XP, you'll be just fine here after a bit of tinkering.

The regular desktop experience is only one part of Windows 10. If you're using a typical laptop or PC, everything will feel familiar, but if you have a touchscreen laptop or a hybrid laptop-tablet, it works for your device too.

The new Desktop includes everything you'd want from Windows, such as a Start menu



Detaching the keyboard or folding your hybrid back on itself switches Windows 10 into tablet mode. The OS will ask you if it should change modes the first time you do this, after which you can make the switch automatic. This worked with every device we had in the office, although they all had sensors to detect the change – some hybrids with clip-on Bluetooth keyboards lack this capability, in which case you'll have to change modes manually.

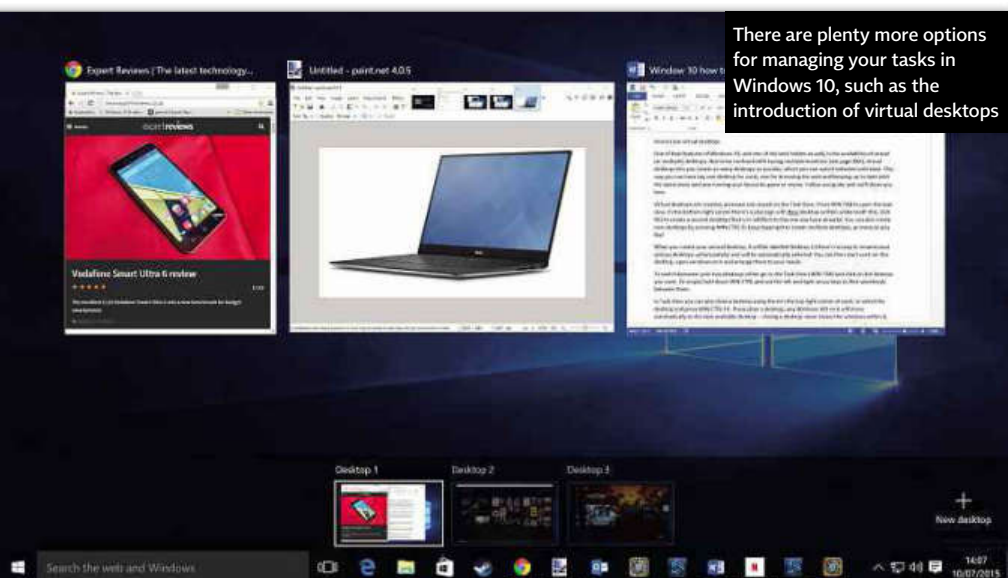
OUT ON THE TILES

In tablet mode you're presented with a full-screen Start menu with large tiled app icons that you can easily tap to launch. Live tiles provide updates from your apps without you having to open them, so you can see photos from social media, weather, news headlines and so on at a glance. The dense tiled layout makes the screen feel far slicker and more modern than either Apple's or Google's mobile operating systems.

The new system also brings in mobile-OS navigation including a back button. In fact, with Windows 10 we could really see ourselves moving to single-device computing, with a laptop-tablet hybrid covering everything we need from both devices.

There are still some sticking points, though. Put simply, full-screen app support for Windows 10 still isn't great. Despite a respectable selection of apps from the big players (Facebook, Netflix, Twitter, Kindle and so on) more local content is thin on the ground (there's no Guardian app, for example). Meanwhile, games that should be available in the Windows Store simply aren't there, including the popular Hearthstone.

There's a good reason for this: why would publishers push their Windows apps through





the store and pay a percentage on everything they earn through it to Microsoft when they can simply make desktop programs and reap any rewards directly? The situation is slightly different for mobile and touchscreen devices, as users are accustomed to using app stores and want a touch-friendly version of an app, but developers need to be sufficiently convinced to stock the store so that Microsoft can compete with iOS and Android.

Windows 10 still has a few rough edges too. For example, the user accounts screen hasn't changed much from previous versions and could do with an update. The new Edge browser is also a little sluggish in all the usual browser benchmarks, although synthetic tests aren't the best way to replicate real-world results, and we've been using it without any real problems. There are also a few things you might miss from previous version of Windows, but nothing that can't be replaced.

In other respects, however, Microsoft has learnt from Windows 8's largely negative reception. The much-hated Charms bar has

gone, and Settings has had a complete makeover for the better. All the key settings are now in one place and within easy reach from the Start menu. The clean and clear design is well spaced so that you can also make changes using a touchscreen.

Speaking of touchscreens, the new Action Centre slides out from the right of the screen with a swipe, providing quick access to the kind of settings you need on a mobile device. You can force your device into tablet mode, adjust screen brightness, engage Flight mode and access the main settings if required.

POWER SNAP

Windows 10 has numerous new tools and shortcuts for keeping all your tasks and windows in check. You can quickly snap windows to full screen, half screen and even quarter screen using a combination of the Windows and cursor keys. When you set a window to fill half the screen, the OS offers up your other open windows to fill the other half. This works well on touchscreen devices too, with swipes and drags replacing the keyboard shortcuts.

Even if you only want to use one app at a time, task switching is much improved thanks to the new Task View. This presents thumbnails of all your open windows so that you can select the one you need. It also shows you any virtual desktops you have and allows you to switch between them.

Yes, that's right: Windows now has built-in virtual desktops, which should be cause for celebration among the more organised users. You can now divide your tasks over numerous desktops with different programs on each – so you can have a desktop for each project you're working on, for example, or one for work and another for play. We were able to flick easily between fullscreen programs on multiple desktops, going from a game to Netflix to a word document in an instant.

As before, Windows 10 happily hosts multiple users. You can set up local accounts for a more traditional desktop experience or use Microsoft accounts for automatic integration with the company's cloud services such as Outlook, Office and OneDrive. Accounts with parental controls are carried over from Windows 8, enabling you to restrict and monitor your children's use of the PC.

Windows 10 has the same system requirements as Windows 7 and 8, and we're pleased to say that the new operating system has no negative impact on performance. Running our 4K benchmarks on a Windows 8.1 system and then running them again after we'd upgraded to Windows 10 revealed near-identical overall scores of 110 and 111 – which is well within the margin of error. In other words, if your computer is happy running Windows 7 or Windows 8 it will be happy running Windows 10.

ONE FOR ALL

Now that Microsoft is finally starting to get to grips with the idea of a mobile-friendly operating system, it makes more and more sense to compare Windows 10 with the competition's mobile offerings. While Apple has kept OS X and iOS separate, Microsoft is providing a single operating system that runs across a wide range of devices, both with and without touchscreens.

In that respect, Windows 10 is a big step forward over its muddled predecessor. It provides a good mobile experience that we hope will only improve with time. Better hardware and more apps are almost a certainty given such a huge user base. Microsoft has done all this while maintaining the highly productive and straightforward desktop operating system that has been around for decades. The desktop OS has also been improved but not in ways that will frustrate or annoy anyone.

In short, we'd advise anyone who can upgrade to do so. If your PC passes the minimum specifications you should be more than happy with Windows 10. It looks better, it works better and it does more, plus it's free for almost everyone (or £100 if not).

Seth Barton

SPECIFICATIONS

OS SUPPORT Upgrade from Windows 7, 8 or 8.1 • **MINIMUM CPU** 1GHz • **MINIMUM GPU** DirectX 9 or later with WDDM 1.0 driver • **MINIMUM RAM** 1GB (32-bit), 2GB (64-bit) • **HARD DISK SPACE** 16GB (32-bit), 20GB (64-bit) • **DETAILS** www.microsoft.com/en-gb/windows



PUZZLE PLATFORMER

FROZENBYTE

Trine 3: The Artifacts of Power



£16 inc VAT • From store.steampowered.com

VERDICT

Trine 3: The Artifacts of Power is a smart, if brief, puzzle platformer that gets cut short by its ambitious design

PLATFORM GAMES OFTEN live or die in the transition from two dimensions to three, so there was always going to be an element of risk in expanding Frozenbyte's high fantasy physics puzzler into 3D. Rather than throw caution to the wind, however, the studio enlisted the help of its players, opening up the game to Steam's Early Access scheme to give early testers a say in what was in store for the next instalment of the Trine series.

What emerged as Trine 3: The Artifacts of Power shows Frozenbyte at the height of its creativity with a more refined and focused platformer than either of its forebears. Every puzzle takes on new life now that players can interact in 360°, and each one makes full use of the three heroes' new abilities. However, it wasn't long before that initial sense of wonder gave way to something more troubling.

The game is short – so lean, in fact, that it ends just as the story prepares to hit its second act. The cost of those extra polygons has proven to be a far greater evil than the game's new villain Sarek, who has shattered the mystical Trine into four pieces, forcing the heroes on a quest to rebuild it. Frozenbyte has admitted as much on the game's Steam Community page, citing escalating development costs as the main reason behind the abrupt ending. The very future of the series is now being called into question.

This is a shame, particularly as there wasn't the slightest hint of trouble during Trine 3's Early Access period. As much as Frozenbyte's honesty in the matter is appreciated, gamers can't help but feel disappointed or that the studio's ambitious plans have clearly got the



There may not be many story missions, but each one has a gorgeous setting that works well with 3D monitors

better of them. Still, even though the game never reaches its full potential, that's not to say that Trine 3's brief adventure isn't worth the journey, as even its handful of levels show that Frozenbyte's platforming prowess is as sharp and elegant as ever.

MOVE CLOSER

Admittedly, part of that elegance is the result of a dramatically reduced move pool. Trine 2's in-depth levelling system appears to be yet another casualty of the move to 3D. However, the abilities that do make the cut give each hero much greater purpose than before. Pontius is a more capable and natural fighter now he can fend off attacks in all directions, and Zoya's new-found lasso skills give her grappling hook equal billing to Amadeus's magical boxes when it comes to puzzle solving.

The latter is a particularly welcome change, as previously Zoya's main strength was her speed and dexterity, allowing her to swing across large gaps with ease and pick off enemies from afar with her bow. However, with Trine 3's ever-decreasing focus on high-pressure combat, the need for a second offensive character becomes less apparent, allowing the studio to concentrate on finding ingenious ways to tax your brain.

For instance, as well as using the grapple hook to open trap doors above you, you can also pull platforms out toward you, creating new paths as you travel deeper into Trine 3's lush and pliable set pieces. Frozenbyte makes excellent use of physics here, too, with heavy doors that can be levered open by attaching the opposite end of Zoya's rope to nearby

posts and objects, often in conjunction with boxes conjured by Amadeus. Sadly Amadeus can't create platforms as well as crates now, but when you're already using every control input just to manoeuvre a box through a 3D space, it's understandable that rotatable platforms were probably a step too far.

It's not something you notice either, as the challenge stages littered across the overworld map are designed to make the most of each character's skill set. While the main quest lets you switch between each character at will, challenge maps are limited to one character, showing off what they can do when pushed out of their naturally defined roles. For instance, Amadeus proves surprisingly lethal when you're tasked with fighting off hordes of monsters with his levitating blocks, while Pontius's gliding kite shield often gives him as much grace and elegance as Zoya when you're skulking through a platform-heavy dungeon.

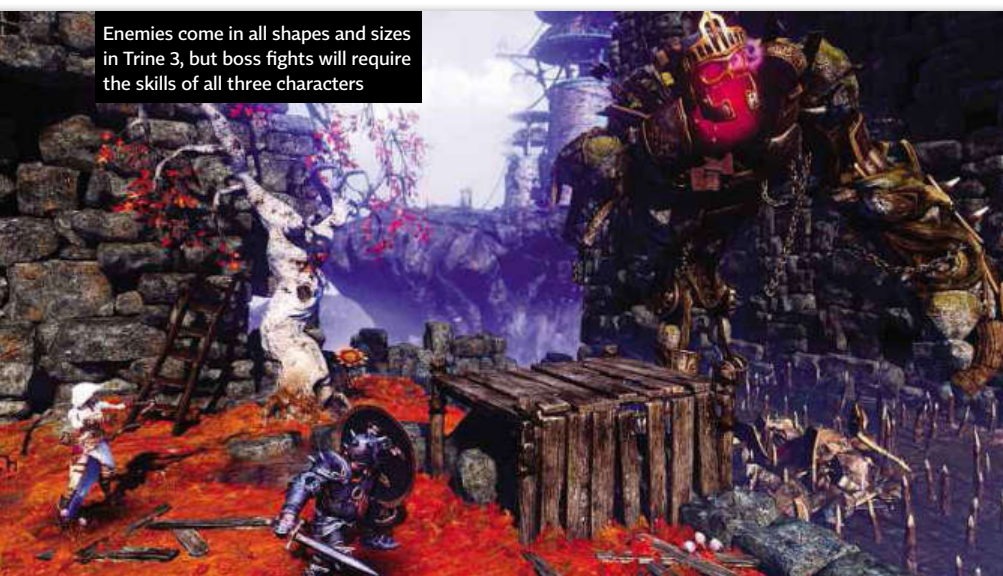
TIPPING THE BALANCE

With all three characters so equally balanced, playing in local and online multiplayer is a real pleasure, as Frozenbyte's myriad of different puzzle solutions remains wholly intact. Admittedly, solo players might not have quite so many lightbulb moments, as the freedom to switch between each character often negates the need to think so creatively, but it's a small complaint when the world is so lovingly rendered (especially on maximum settings) and such a joy to behold.

It's just a shame it all ends so suddenly, as it never really feels like Trine 3 reaches its full potential. Frozenbyte is clearly capable of achieving so much more with 3D platforming, but it would be a major shame if this is indeed the end of such a fantastic series. With so much left unsaid, Trine 3 narrowly misses out on a full recommendation, but it's still great fun while it lasts, and fans of the series should relish every last detail.

Katharine Byrne

Enemies come in all shapes and sizes in Trine 3, but boss fights will require the skills of all three characters



SPECIFICATIONS

AVAILABLE FORMATS PC • **OS SUPPORT** Windows Vista/7/8/10 • **MINIMUM CPU** Intel Core i3/i5/i7 1.8GHz dual-core, AMD 2GHz dual-core • **MINIMUM RAM** 4GB • **MINIMUM GPU** Nvidia GeForce 260, Radeon HD 4000 Series, Intel HD Graphics 4000 • **HARD DISK SPACE** 6GB • **DETAILS** www.frozenbyte.com

Drive Performance to Another Level



Solid State Drives SATA III 6Gb/s

- Powerful controller with ultra-fast MLC flash chips
- Supports DevSleep ultra low power state
- Supports TRIM, NCQ and S.M.A.R.T. functions
- Silent, low-power operation. Resistant to shock and vibration
- Three-year limited warranty

★
**3X Faster
than HDD**

★
Ultra slim

★
High IOPS



SDXC/SDHC UHS-I U3 32GB~64GB

- MLC flash-based performance and reliability
- Smooth Full HD, 3D, and 4K video recording performance
- Improved camera response for fast-action consecutive shooting
- Built-in Error Correcting Code (ECC) to detect and correct transfer errors
- Exclusive RecoveRx photo recovery software



microSDHC Class 10 UHS-I 8GB ~ 32GB

- MLC flash-based performance and reliability
- Perfect fit for action cameras to capture every single move
- Ideal upgrade for smartphones, tablets, and digital cameras
- Improved camera response for fast-action consecutive shooting
- Exclusive RecoveRx photo recovery software



Wi-Fi SD Card 16GB ~ 32GB

- Wirelessly stream different content to 3 devices simultaneously
- Use your tablet/smartphone to review photos in real time
- Upload photos directly to social networking profile
- Supports iOS, Android, Windows, Linux, and Mac OS X



For more information, please visit <http://uk.transcend-info.com> or contact 01442-838280

Available from:

memoryC.com

Ireland and UK's leading specialised distributor of memory and storage products

Choosing a ...

PC system

01 A basic PC costing around £350 will be able to run everyday office, multimedia and education software and will easily cope with the internet. It might even be able to run some modern games. Many PCs can be sold either with or without the monitor. If you don't like the display that the manufacturer is offering, you can always use your current one, or buy one separately.

02 If you want to play games, you'll have to upgrade the graphics card. Budget cards such as the AMD Radeon R7 260X will cope well with many 3D games, but to play the latest 3D games smoothly (and enjoy the best-quality graphics) it's worth upgrading to a more powerful card such as an Nvidia GeForce GTX 960.

03 All modern PCs come with at least a dual-core processor and are capable of most tasks. Anyone who regularly undertakes demanding tasks such as video editing and encoding should consider a quad-core or even hex-core processor.

04 There are plenty of good reasons to upgrade the PC's memory or hard disk. If you'll use your PC for gaming, video-editing or other demanding tasks, you'll need 8GB of RAM and a large hard disk – 1TB should suffice. Many new PCs come with SSDs, which make your PC boot and load programs incredibly quickly.

05 Having plenty of USB ports is always useful, as most PC peripherals attach to these. Most new PCs come with USB3 ports, which provide faster data transfers when used with supported devices.

06 Most new PCs come with Windows 10 installed. Don't be too easily swayed by the inclusion of other software. It may be that you'll never use it.

07 While most PCs come in cases of a similar size, some have more compact mini tower or mini-PC cases. These smaller PCs will fit under your TV or on your desk more easily, but bear in mind that they're significantly harder to upgrade than full-size machines.

PCs



CHILLBLAST Fusion Wolf



£1,800 inc VAT • www.chillblast.com

One of the most powerful all-round PCs we've seen in months, the Fusion Wolf will blast through any game you throw at it at Ultra HD resolutions, and its overclocked processor will ease its way through any multimedia task.

PROCESSOR Quad-core 4.4GHz Intel Core i7-4790K (overclocked) • **RAM** 16GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 4x USB, 4x USB3 • **TOTAL STORAGE** 256GB SSD, 2TB hybrid hard disk (8GB SSD cache) • **GRAPHICS CARD** 6GB Nvidia GeForce GTX 980 Ti • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 • **WARRANTY** Two years collect and return with parts, three years labour-only RTB • **DETAILS** www.chillblast.com • **PART CODE** Fusion Wolf • **FULL REVIEW** Sep 2015



ACER Revo One RL85



£350 inc VAT • www.staples.co.uk

One of the cleverest PC designs we've seen in ages, the tiny Acer Revo One has enough space for three high-capacity hard disks, making it a perfect living-room PC. With an Intel Core i3 processor, it's no slouch either, and the price is as attractive as the chassis.

PROCESSOR Dual-core 1.7GHz Intel Core i3-4005U • **RAM** 4GB • **FRONT USB PORTS** 0 • **REAR USB PORTS** 2x USB, 2x USB3 • **TOTAL STORAGE** 2TB hard disk • **GRAPHICS CARD** Integrated Intel HD 4000 graphics • **OPERATING SYSTEM** Windows 8.1 • **WARRANTY** One year RTB • **DETAILS** www.acer.co.uk • **PART CODE** DT.SZMEK.014 • **FULL REVIEW** Aug 2015



PALICOMP i5 Devil Blaster



£700 inc VAT • www.palicmp.co.uk

Palicomp has created an eminently powerful system for the money. The i5 Devil Blaster has terrific gaming performance and the system's overclocked i5-4690K processor provides great application performance. A decent monitor rounds off a great-value system.

PROCESSOR Quad-core 4.5GHz Intel Core i5-4690K (overclocked) • **RAM** 8GB • **FRONT USB PORTS** 1x USB3, 1x USB • **REAR USB PORTS** 4x USB3, 2x USB • **TOTAL STORAGE** 1TB hybrid hard disk • **GRAPHICS CARD** 2GB PowerColor AMD Radeon R9 270X • **DISPLAY** 24in Iiyama ProLite E2483HS • **OPERATING SYSTEM** Windows 10 • **WARRANTY** Three years RTB, one year parts • **DETAILS** www.palicmp.co.uk • **PART CODE** HAS8 • **FULL REVIEW** Dec 2014



LAPTOPS



ASUS ZenBook UX305



£600 inc VAT • www.johnlewis.com

The UX305 is Asus's first laptop that runs Intel's new low-power Core M processors. Weighing just 1.2kg and 12mm thick, it's one of the thinnest and lightest laptops we've ever tested. Its performance won't set the world alight, but if you're after a portable work machine, look no further.

PROCESSOR Dual-core 800MHz Intel Core M-5Y10C • **RAM** 8GB • **DIMENSIONS** 324x226x12mm • **WEIGHT** 1.2kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel HD 5300 • **TOTAL STORAGE** 128GB SSD • **OPERATING SYSTEM** Windows 8.1 • **PARTS AND LABOUR WARRANTY** One year collect and return • **DETAILS** www.asus.com • **PART CODE** UX305FA(MS)-FC061H • **FULL REVIEW** Jun 2015



SCAN 3XS Graphite LG157



£918 inc VAT • www.scan.co.uk/3xs

Scan has created a successful follow-up to its Graphite LG156 with an excellent screen and build quality improvements. You also get a generous two-year warranty, making the Graphite LG157 a great choice.

PROCESSOR Quad-core 2.5GHz Intel Core i7-4710HQ • **RAM** 8GB • **DIMENSIONS** 385x268x29mm • **WEIGHT** 2.5kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Nvidia GeForce GTX 960M • **TOTAL STORAGE** 120GB SSD, 1TB hard disk • **OPERATING SYSTEM** Windows 10 • **PARTS AND LABOUR WARRANTY** Two years RTB • **DETAILS** www.scan.co.uk/3xs • **PART CODE** 3XS Graphite LG157 • **FULL REVIEW** Aug 2015



TOSHIBA Chromebook 2 (CB30-B-104)



£240 inc VAT • www.pcworld.co.uk

Toshiba's Chromebook 2 is the first budget Chromebook on sale in the UK with a Full HD screen. This increases the price a little but we think it's absolutely worth it. With so much extra real estate, you can fit more items on the screen and get more done. The machine is lighter and has better battery life than its predecessor, too, making it our current favourite Chromebook.

PROCESSOR Dual-core 2.16GHz Intel Celeron N2840 • **RAM** 4GB • **DIMENSIONS** 320x214x19mm • **WEIGHT** 1.35kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Intel HD Graphics • **TOTAL STORAGE** 16GB SSD • **OPERATING SYSTEM** Google Chrome OS • **PARTS AND LABOUR WARRANTY** One year RTB • **DETAILS** www.toshiba.co.uk • **PART CODE** PLMOZE-00D003EN • **FULL REVIEW** May 2015



SMARTPHONES

COMPUTER SHOPPER
RECOMMENDED

SAMSUNG Galaxy S6

★★★★★

£410 SIM-free, free on £32-per-month contract • www.handtec.co.uk (SIM-free), www.carphonewarehouse.com (contract)

The all-metal Galaxy S6 is one of Samsung's best phones yet. Its performance is among the best we've seen and its 2,560x1,440 screen looks gorgeous. If you want a phone to really turn heads, though, there's also the curvy Galaxy S6 Edge.

PROCESSOR Quad-core 2.1GHz 8 quad-core 1.5GHz Samsung Exynos 7420 • SCREEN SIZE 5.1in • SCREEN RESOLUTION 2,560x1,440 • REAR CAMERA 16 megapixels • STORAGE 32GB • WIRELESS DATA 4G • DIMENSIONS 143x70x6.8mm • WEIGHT 132g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • DETAILS www.samsung.co.uk • PART CODE SM-G920F • FULL REVIEW Jul 2015



COMPUTER SHOPPER
BEST BUY

APPLE iPhone 6

★★★★★

£539 SIM-free, free on £32-per-month contract • store.apple.com (SIM-free), www.carphonewarehouse.com (contract)

It took Apple a while, but it finally increased screen size with the iPhone 6 range. Now with a 4.7in display, a fast processor, improved battery life and iOS 8.3, the iPhone 6 is an improvement in every way on the iPhone 5s.

PROCESSOR Dual-core 1.4GHz Apple A8 • SCREEN SIZE 4.7in • SCREEN RESOLUTION 1,334x750 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 138x67x6.9mm • WEIGHT 129g • OPERATING SYSTEM iOS 8.3 • WARRANTY One year RTB • DETAILS www.apple.com/uk • PART CODE iPhone6 • FULL REVIEW Dec 2014



COMPUTER SHOPPER
BEST BUY

SONY Xperia Z3 Compact

★★★★★

£300 SIM-free, free on £23.50-per-month contract • www.handtec.co.uk (SIM-free), www.o2.co.uk (contract)

With its incredible 20-hour battery life and fast performance, the Sony Xperia Z3 Compact brings flagship features to a smaller handset at a great price.

PROCESSOR Quad-core 2.5GHz Qualcomm Snapdragon 801 • SCREEN SIZE 4.6in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 20.7 megapixels • STORAGE 16GB • WIRELESS DATA 4G • DIMENSIONS 127x65x8.6mm • WEIGHT 129g • OPERATING SYSTEM Android 4.4 • DETAILS www.sony.co.uk • PART CODE Sony D5803 • FULL REVIEW Jan 2015



COMPUTER SHOPPER
BEST BUY

MICROSOFT Lumia 640

★★★★★

£120 SIM-free, free on £10.50-per-month contract • www.argos.co.uk (SIM-free), www.idmobile.co.uk (contract)

The best budget Windows phone around. Its 5in screen is fantastic and its snappy performance punches above its price range. There's also the jumbo Lumia 640 XL if you want more battery life.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 400 • SCREEN SIZE 5in • SCREEN RESOLUTION 1,280x720 • REAR CAMERA 8 megapixels • STORAGE 8GB • WIRELESS DATA 4G • DIMENSIONS 141x72x8.8mm • WEIGHT 145g • OPERATING SYSTEM Windows Phone 8.1 • DETAILS www.microsoft.com • PART CODE RM-1072 • FULL REVIEW Aug 2015



COMPUTER SHOPPER
RECOMMENDED

MOTOROLA Moto E (2nd Gen)

★★★★★

£109 SIM-free, free on £8.50-per-month contract • www.motorola.co.uk (SIM-free), www.idmobile.co.uk (contract)

The new 4G Moto E is a smartphone bargain. It feels just as well made as the Moto G and its web browsing performance isn't that far behind, either.

PROCESSOR Quad-core 1.2GHz Qualcomm Snapdragon 410 • SCREEN SIZE 4.5in • SCREEN RESOLUTION 960x540 • REAR CAMERA 5 megapixels • STORAGE 8GB • WIRELESS DATA 3G, 4G • DIMENSIONS 130x67x12.3mm • WEIGHT 145g • OPERATING SYSTEM Android 5.0.2 • WARRANTY One-year RTB • DETAILS www.motorola.co.uk • PART CODE XT1505 • FULL REVIEW Jun 2015



TABLETS

COMPUTER SHOPPER
RECOMMENDED

SONY Xperia Z4 Tablet

★★★★★

£499 inc VAT • www.johnlewis.com

It's expensive, but the Z4 Tablet is a stunning bit of kit. It weighs just 389g, so is lighter than the iPad Air 2, and is an amazing 6.1mm thick. Its super-high-resolution screen has the best colour accuracy we've seen from an LCD panel, it runs Android 5 beautifully and has the best battery life we've ever seen from a tablet.

PROCESSOR Dual-core 2GHz Qualcomm Snapdragon 810 • SCREEN SIZE 10.1in • SCREEN RESOLUTION 2,560x1,600 • REAR CAMERA 8.1 megapixels • STORAGE 32GB • WIRELESS DATA 4G (optional) • DIMENSIONS 167x254x6.1mm • WEIGHT 389g • OPERATING SYSTEM Android 5 • WARRANTY One year RTB • DETAILS www.sonymobile.com • PART CODE Xperia Z4 Tablet • FULL REVIEW Aug 2015



COMPUTER SHOPPER
BEST BUY

GOOGLE Nexus 9

★★★★★

£300 inc VAT • www.currys.co.uk

The Nexus 9 is the first Google-branded tablet to have an iPad-style 4:3 ratio screen, which we think is a better shape for web browsing. Android 5.0 Lollipop runs beautifully and its battery life is superb.

PROCESSOR Dual-core 2.3GHz 64-bit Nvidia Tegra K1 Denver • SCREEN SIZE 8.9in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 154x228x8.8mm • WEIGHT 425g • OPERATING SYSTEM Android 5.0 • WARRANTY One year RTB • PART CODE Nexus 9 • DETAILS www.google.com/nexus/9 • FULL REVIEW Aug 2015



COMPUTER SHOPPER
RECOMMENDED

APPLE iPad Air 2

★★★★★

£399 inc VAT • store.apple.com/uk

The iPad Air 2 is even thinner and lighter than its predecessor and still feels beautifully made. It's the fastest iPad yet, and now has TouchID fingerprint recognition for added security.

PROCESSOR Tri-core 1.5GHz Apple A8X • SCREEN SIZE 9.7in • SCREEN RESOLUTION 2,048x1,536 • REAR CAMERA 8 megapixels • STORAGE 16GB • WIRELESS DATA 4G (optional) • DIMENSIONS 240x170x6.1mm • WEIGHT 457g • OPERATING SYSTEM iOS 8.3 • WARRANTY One year RTB • PART CODE Apple iPad Air 2 • DETAILS www.apple.com/uk • FULL REVIEW Aug 2015



COMPUTER SHOPPER
RECOMMENDED

MICROSOFT Surface 3

★★★★★

£499 inc VAT • www.microsoftstore.com

If you're after a Windows tablet but the £600-plus Surface Pro 3 is too much for you, the Surface 3 is the model to get. It's beautifully made with a great screen, and if you add the optional Type Cover keyboard you'll have a super-light laptop for working on the move.

PROCESSOR Quad-core 1.6GHz Intel Atom X7-28700 • SCREEN SIZE 10.8in • SCREEN RESOLUTION 1,920x1,280 • REAR CAMERA 8 megapixels • STORAGE 128GB • WIRELESS DATA 4G (coming soon) • DIMENSIONS 187x267x8.7mm • WEIGHT 622g • OPERATING SYSTEM Windows 10 (64-bit) • WARRANTY One year RTB • DETAILS www.microsoft.com • PART CODE Surface 3 • FULL REVIEW Aug 2015



COMPUTER SHOPPER
BEST BUY

TESCO Hudl 2

★★★★★

£99 inc VAT • www.tesco.com/direct/hudl

The Hudl 2 is even better value than the original. It has a great screen, good build quality and runs Android smoothly. Battery life isn't great, but otherwise this is a fantastic complete budget tablet.

PROCESSOR Quad-core 1.3GHz Intel Atom Z3750 • SCREEN SIZE 8.3in • SCREEN RESOLUTION 1,920x1,200 • REAR CAMERA 5 megapixels • STORAGE 16GB • WIRELESS DATA None • DIMENSIONS 224x128x9mm • WEIGHT 410g • OPERATING SYSTEM Android 4.4.2 • WARRANTY One year RTB • PART CODE hudl2 • DETAILS www.tesco.com/direct/hudl • FULL REVIEW Aug 2015



Choosing a ...

Tablet

01 All tablets rely on an operating system (OS) to run apps. You have two main choices: Apple's iOS, which runs on the iPad Air and iPad Mini, and Android, which Google licenses to various manufacturers. If you own an Apple or Google smartphone, you can download your apps, music and so on to a tablet that runs the same OS, so it makes sense to stick with a compatible device. There are also Windows RT tablets, which use a cut-down version of Windows 8, but they are much less common.

02 It's important to pick a tablet that has a good-quality high-resolution screen. Many budget tablets have 1,280x800-resolution displays, but better tablets have Full HD 1,920x1,080 panels, and we're starting to see tablets that have even higher screen resolutions. Some are as high as 2,560x1,600. Entry-level tablets typically use TN panels, which don't have particularly good viewing angles. The viewing angles of IPS panels are much better.

03 If you want to listen to music, watch films and play games, make sure your tablet has plenty of storage. Many tablets come with 8GB or 16GB of internal storage as standard, although some budget models have less. You'll typically pay more for a higher storage capacity. Many tablets also have microSD slots that let you add extra storage, although you won't find one on an iPad. MicroSD cards are a cheap way of boosting storage capacity.

04 Tablets rarely include a SIM card slot. This means you'll have to rely on Wi-Fi to get online, although some tablets let you access the internet through your smartphone. If you want mobile access to the internet, look for 3G- and 4G-ready devices. These almost always cost more than Wi-Fi-only models but they're great if you use your tablet while commuting or travelling.

05 Your choice of tablet determines the apps you can use on it. You may find that some of the apps you want are available on iOS but not Android and vice versa. Android and iOS devices currently have more apps available than Windows RT.

Choosing a...

Monitor

01 A basic 24in LCD monitor costs around £100. It will be fine for typical Windows work but is likely to have poor viewing angles, so you'll need to sit straight on to achieve the best picture quality. Its colour accuracy may not be very good, though.

02 A VGA input lets you use the monitor with any PC, but the quality may not be as good as it is over DVI or HDMI. Both are digital connections and require a compatible graphics card but they avoid the need for digital-to-analogue or analogue-to-digital conversions, which can reduce image quality. A digital connection achieves the best picture automatically, so you won't have to adjust clock or phase settings as you do with analogue connections.

Many DVI and all HDMI connections support HDCP, which lets you watch protected video content, such as Blu-ray movies. DisplayPort is becoming more popular, but you'll need a graphics card with a DisplayPort output (mini or full-size) to use this input on your monitor.

03 A larger monitor will be easier on the eye and may have a higher resolution. Most monitors have resolutions of at least 1,920x1,080 (1080p), which provide lots of room for working with multiple windows at the same time. For even higher resolutions, you'll need a larger display. Some 27in and 30in screens have 2,560x1,600 or even 4K resolutions. You'll need a graphics card with a dual-link DVI output and a dual-link DVI cable or either HDMI or DisplayPort to use a monitor at these resolutions.

04 If you want better picture quality, look for a monitor with a high contrast ratio. The higher the ratio, the whiter the whites and the blacker the blacks. You'll also be able to see more fine detail in images with high contrast levels. Viewing angles are important, as wider angles mean you don't have to sit directly in front of the monitor to get the best picture. Wider viewing angles also allow more people to view the screen at the same time.

Fast response times reduce ghosting, but don't be dazzled by the numbers. A response time of 25ms or quicker is fine for all applications.

PHOTOGRAPHY

COMPACT SYSTEM CAMERA	<p>COMPUTER SHOPPER SAMSUNG NX3000 RECOMMENDED ★★★★★ £229 inc VAT • www.ukdigitalcameras.co.uk</p> <p>With its high image quality, wealth of features and slim design, the NX3000 is an excellent camera. Better still, at its current low price it's an unbelievable bargain. Buy one while you can.</p> <p>SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 23.5x15.7mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.5x • VIEWFINDER None • LCD SCREEN 3in (460,800 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 3.1x (24-75mm) • 35mm-EQUIVALENT APERTURE f/5.2-8.4 • LENS MOUNT Samsung NX • WEIGHT 386g • DIMENSIONS 61x126x78mm • WARRANTY One year RTB • DETAILS www.samsung.com/uk • FULL REVIEW Jan 2015</p>	
COMPACT CAMERA	<p>COMPUTER SHOPPER NIKON Coolpix S9700 BEST BUY ★★★★★ £150 inc VAT • www.buyacamera.co.uk</p> <p>This compact camera packs in a 30x zoom lens, Wi-Fi, GPS and slow-motion video. Its has a comprehensive set of controls, but it's the image quality that really impresses, achieving decent shots in tough conditions.</p> <p>SENSOR RESOLUTION 16 megapixels • SENSOR SIZE 1/2.3in • VIEWFINDER None • LCD SCREEN 3in (921,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 30x (25-750mm) • 35mm-EQUIVALENT APERTURE f/21-36 • WEIGHT 235g • DIMENSIONS 66x110x34mm • WARRANTY Two years RTB • DETAILS www.nikon.co.uk • FULL REVIEW Nov 2014</p>	
ULTRA-ZOOM CAMERA	<p>COMPUTER SHOPPER PANASONIC Lumix DMC-FZ200 BEST BUY ★★★★★ £309 inc VAT • www.johnlewis.com</p> <p>This ultra-zoom camera has a big 25-600mm zoom range and maintains a fast F2.8 aperture across the whole focal range, so you can shoot in low-light conditions without too much worry.</p> <p>SENSOR RESOLUTION 12.1 megapixels • SENSOR SIZE 6.2x4.6mm (1/2.3in) • VIEWFINDER Electronic • LCD SCREEN 3in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 24x (25-600mm) • 35mm-EQUIVALENT APERTURE f/15.5-9 • WEIGHT 588g • DIMENSIONS 87x125x110mm • WARRANTY One year RTB • DETAILS www.panasonic.com/uk • FULL REVIEW Feb 2013</p>	
CONSUMER SLR	<p>COMPUTER SHOPPER CANON EOS 750D BEST BUY ★★★★★ £577 inc VAT (with 18-55mm kit lens) • www.jessops.com</p> <p>The 750D is the new mainstay of Canon's SLR line-up. Better autofocus, D5500-beating image quality and decent video too: this is the mid-range SLR to buy. Also comes with extra manual controls as the 760D.</p> <p>SENSOR RESOLUTION 24 megapixels • SENSOR SIZE 22.3x14.9mm (APS-C) • FOCAL LENGTH MULTIPLIER 1.6x • VIEWFINDER Optical • LCD SCREEN 5in • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 3x (29-88mm) • 35mm-EQUIVALENT APERTURE f/5.6-9 • LENS MOUNT Canon EF-S • WEIGHT 771g • DIMENSIONS 104x132x148mm • WARRANTY One year RTB • DETAILS www.canon.co.uk • FULL REVIEW Oct 2015</p>	
COMPACT CAMERA	<p>COMPUTER SHOPPER CANON PowerShot G7 X BEST BUY ★★★★★ £388 inc VAT • www.wexphotographic.com</p> <p>With near SLR-quality stills in a truly pocketable package, the PowerShot G7 X is a huge step up from most other compact cameras - and at an excellent price.</p> <p>SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 1in • VIEWFINDER None • LCD SCREEN 3in (1,040,000 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 4.2x (24-100mm) • 35mm-EQUIVALENT APERTURE f/4.9-7.6 • WEIGHT 301g • DIMENSIONS 64x107x40mm • WARRANTY One year RTB • DETAILS www.canon.co.uk • FULL REVIEW May 2015</p>	

DISPLAYS

MONITOR	<p>COMPUTER SHOPPER BENQ GW2765HT BEST BUY ★★★★★ £275 inc VAT • www.cclonline.com</p> <p>This 27in 2,560x1,440 IPS monitor is one of the best-value screens we've ever seen. With near-perfect sRGB colour accuracy out of the box, it's a steal for less than £300.</p> <p>SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI, DisplayPort • WARRANTY Two years onsite • PART CODE GW2765HT • DETAILS www.benq.co.uk • FULL REVIEW Jan 2015</p>	
MONITOR	<p>COMPUTER SHOPPER VIEWSONIC VX2363Smhl-W RECOMMENDED ★★★★★ £125 inc VAT • www.ebuyer.com</p> <p>The 23in VX2363Smhl-W stands out from the crowd with its white stand, IPS screen and great overall image quality. It's a good budget buy for those who have modest needs.</p> <p>SCREEN SIZE 23in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • VIDEO INPUTS VGA, DVI, HDMI, tx MHL-compatible HDMI • WARRANTY Two years collect and return • PART CODE VX2363Smhl-W • DETAILS www.viewsoniceurope.com • FULL REVIEW Jan 2015</p>	
MONITOR	<p>COMPUTER SHOPPER IYAMA ProLite GB2488HSU-B1 BEST BUY ★★★★★ £205 inc VAT • www.box.co.uk</p> <p>Gamers need look no further than the Iiyama ProLite GB2488HSU-B1. It's a no-nonsense Full HD panel with a 144Hz refresh rate for lightning-fast games.</p> <p>SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY TN • VIDEO INPUTS 2x HDMI, DVI, DisplayPort • WARRANTY Two years onsite • PART CODE ProLite GB2488HSU-B1 • DETAILS www.iiyama.com • FULL REVIEW Aug 2014</p>	
MONITOR	<p>COMPUTER SHOPPER ASUS PB279Q BEST BUY ★★★★★ £563 inc VAT • www.balllicom.co.uk</p> <p>If you're remotely serious about design, photography or gaming and want an Ultra HD screen, this is the monitor to choose. It's plain to look at and has no USB hub, but in terms of pure image quality, nothing beats it at this price.</p> <p>SCREEN SIZE 27in • RESOLUTION 3,840x2,160 • SCREEN TECHNOLOGY AHVA • REFRESH RATE 60Hz • VIDEO INPUTS 4x HDMI, DisplayPort, Mini DisplayPort • WARRANTY Three years RTB • DETAILS www.asus.com • FULL REVIEW Apr 2015</p>	
MONITOR	<p>COMPUTER SHOPPER SAMSUNG S32D850T BEST BUY ★★★★★ £430 inc VAT • www.laptopsdirect.co.uk</p> <p>It's not cheap, but this 32in monitor is great value. Images are sharp and vibrant on its 2,560x1,440 panel, and the stand is among the most attractive we've seen.</p> <p>SCREEN SIZE 32in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY VA • VIDEO INPUTS HDMI, DVI, DisplayPort • WARRANTY Two years collect and return • PART CODE S32D850T • DETAILS www.samsung.com/uk • FULL REVIEW Jan 2015</p>	

Choosing a ...

Soundbar

01 If you simply don't have room in your home cinema setup for a set of surround sound speakers, a soundbar is the next best thing. Whether you opt for a soundbar – which typically sits in front of your TV stand – or a soundplate, which sits underneath your TV, you'll be getting significantly better audio than the weedy speakers today's flatscreen TVs provide.

02 If you want to cut down on cable clutter, look for a soundbar with multiple HDMI inputs and outputs as well as Audio Return Channel (ARC). Not all soundbars use HDMI, with many making do with digital optical audio connections instead. This means you'll have to connect Blu-ray players, games consoles and set-top boxes to your TV and run all audio through a single cable. Also look for phono inputs for connecting older devices and 3.5mm audio jacks for tablets or smartphones.

03 As with any speaker, the number of speaker drivers inside a soundbar should give a good indication of its audio capabilities. Although this won't tell you everything about sound quality, you should still look out for separate mid-range drivers and tweeters, as these should be able to deliver a wider frequency range than full-range drivers alone.

04 Bluetooth support is a must if you want to listen to music from a smartphone or tablet without wires. Most soundbars now include Bluetooth as standard, but if your device supports it it's worth looking for a model that includes aptX. This less-lossy codec is capable of higher quality streaming than the standard A2DP profile. Airplay streaming is less common, but iPhone owners should keep an eye out for it.

05 For a little extra bass, be sure to look for a soundbar with a subwoofer. Many include a wired sub, but for extra convenience you should look for a model with a wireless subwoofer instead. These can be placed anywhere in a room with a power socket, without having to run a cable back to the soundbar itself.

HOME CINEMA

COMPUTER SHOPPER **LG 47LB730V**
BEST BUY ★★★★★

£570 inc VAT • www.nigelohara.com

The LG 47LB730V has one of the best screens and smart TV interfaces we've seen. With its fantastic design and great picture quality straight out of the box, the 47LB730V is great value.

SCREEN SIZE 47in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, component, composite • TUNER Freeview HD • DIMENSIONS 1,061x666x227mm • WARRANTY Five years RTB • DETAILS www.lg.com/uk • PART CODE 47LB730V • FULL REVIEW Mar 2015



COMPUTER SHOPPER **FINLUX 48FT3E242S-T**
RECOMMENDED ★★★★★

£350 inc VAT • finlux.co.uk

If you're after an ultra-cheap second TV, the this might be right up your street. It lacks a few catch-up and on-demand services, so you might need to extend this with a cheap set-top box. For a 48in TV, it's a cracking bargain

SCREEN SIZE 48in • NATIVE RESOLUTION 1,920x1,080 • VIDEO INPUTS 3x HDMI, SCART, VGA composite • TUNER Freeview HD • DIMENSIONS 1,084x220x720mm • WARRANTY One year RTB • DETAILS www.finlux.co.uk • PART CODE 48FT3E242S-T • FULL REVIEW Jul 2015



COMPUTER SHOPPER **ONKYO TX-NR636**
BEST BUY ★★★★★

£300 inc VAT • www.richersounds.com

With multiple HDMI 2.0 ports for 4K content and Dolby Atmos Home support, the Onkyo TX-NR636 is an essential AV receiver if you're looking to futureproof your home cinema system.

HDMI INPUTS/OUTPUTS 7/2 • HDMI 2.0 INPUTS/OUTPUTS 5/1 • OUTPUT RESOLUTIONS 720p, 1080p, 4K • WIRELESS SUPPORT 802.11n, Bluetooth 2.1 • SPEAKER CONFIGURATION 7.2 • RMS POWER OUTPUT 1,200W • DIMENSIONS 435x173x329mm • WARRANTY Two years RTB • DETAILS www.eu.onkyo.com • PART CODE TX-NR636 • FULL REVIEW Jun 2015



COMPUTER SHOPPER **LG LHB725**
RECOMMENDED ★★★★★

£399 inc VAT • www.johnlewis.com

A 3D-capable home cinema surround system with a Blu-ray player that has fantastic image quality and speakers that deliver powerful sound, all housed in an attractive package.

HDMI INPUTS/OUTPUTS 2/1 • HDMI 2.0 INPUTS/OUTPUTS 2/1 • OUTPUT RESOLUTIONS 720p, 1080p • WIRELESS SUPPORT 802.11n, Bluetooth • SPEAKER CONFIGURATION 5.1 • RMS POWER OUTPUT TOTAL 1,200W • DIMENSIONS 410x55x260mm • WARRANTY One year RTB • DETAILS www.lg.com/uk • PART CODE LHB725 • FULL REVIEW Oct 2015



COMPUTER SHOPPER **SAMSUNG HW-J7500**
RECOMMENDED ★★★★★

£543 inc VAT • www.nigelohara.com

This curved 8.1 soundbar and wireless subwoofer not only looks great, but it also produces excellent sound and has plenty of ports.

SPEAKERS 8 • RMS POWER OUTPUT 320W • DOCK CONNECTOR None • NETWORKING Bluetooth 3.0 • DIMENSIONS 1,230x170x42mm (soundbar), 291x371x291mm (subwoofer) • WEIGHT 4kg (soundbar), 7.8kg (subwoofer) • WARRANTY One year RTB • DETAILS www.samsung.com/uk • PART CODE HW-J7500 • FULL REVIEW Jul 2015



AUDIO

COMPUTER SHOPPER **PHILIPS Fidelio M2BT**
BEST BUY ★★★★★

£185 inc VAT • www.amazon.co.uk

The Philips Fidelio M2BT are premium Bluetooth headphones that sound great, look fantastic and are supremely comfortable.

HEADPHONES TYPE On-ear Bluetooth • PLUG TYPE 3.5mm jack plug • WEIGHT 190g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS www.philips.co.uk • PART CODE M2BTBK/00 • FULL REVIEW Apr 2015



COMPUTER SHOPPER **BLUESOUND Pulse**
RECOMMENDED ★★★★★

£599 inc VAT • www.sevenoakssoundandvision.co.uk

The audiophile's choice for multiroom audio. The Bluesound Pulse has excellent sound quality, support for high-resolution audio and is compatible with plenty of music-streaming services.

SPEAKERS 5 • RMS POWER OUTPUT 80W • DOCK CONNECTOR None • WIRELESS 802.11n Wi-Fi, 10/100 Ethernet, optional Bluetooth (SBC) • DIMENSIONS 420x190x197mm • WEIGHT 1.1kg • WARRANTY One year RTB • DETAILS www.bluesound.com • FULL REVIEW Mar 2015



COMPUTER SHOPPER **RAZER Leviathan**
RECOMMENDED ★★★★★

£150 inc VAT • www.box.co.uk

Soundbars are usually built for TVs, but Razer's Leviathan is ideal for sliding underneath a computer monitor. It sounds great and is more than loud enough to fill a room.

SPEAKERS 4 • RMS POWER OUTPUT 30W • WEIGHT 2kg (bar), 2.3kg (subwoofer) • NETWORKING Bluetooth (SBC, aptX) • WARRANTY Two years RTB • DETAILS www.razerzone.com • PART CODE RZ05-01260100-R3G1 • FULL REVIEW Jul 2015



COMPUTER SHOPPER **ULTIMATE EARS UE Megaboom**
RECOMMENDED ★★★★★

£250 inc VAT • www.currys.co.uk

The UE Megaboom is an intensely loud and powerful Bluetooth speaker that provides a warm and impactful sound. It's waterproof, too, so could provide some entertainment poolside or at your next barbecue.

SPEAKERS 4 • RMS POWER OUTPUT Not disclosed • DOCK CONNECTOR None • WIRELESS Bluetooth (SBC) • DIMENSIONS 83x83x226mm • WEIGHT 877g • WARRANTY Two year RTB • DETAILS www.ultimateears.com • PART CODE UE Megaboom • FULL REVIEW Aug 2015



COMPUTER SHOPPER **ARCAM miniBlink**
RECOMMENDED ★★★★★

£100 inc VAT • www.petertyson.co.uk

Stream music from your mobile phone or tablet to your hi-fi with the petite and attractive miniBlink. This high-quality Bluetooth receiver sounds good and is delightfully simple to use.

WARRANTY Two years RTB • PART CODE miniBlink • DETAILS www.arcam.co.uk • FULL REVIEW Aug 2014



SMART TV

SMART TV

AV RECEIVER

HOME CINEMA SYSTEM

SOUNDBAR/SUBWOOFER

ON-EAR HEADPHONES

PORTABLE SPEAKER

PC GAMING SOUNDBAR

BLUETOOTH SPEAKER

AUDIO INTERFACE

Choosing a...

Laser printer

01 Laser printers used to be much more expensive than inkjets and were typically restricted to offices. They are now much more affordable, however, and offer several benefits over inkjets, including lower per-page printing costs and faster print speeds.

02 A decent laser printer will typically cost around £80, and will happily print hundreds of black and white pages per hour. If documents are your priority, you'll want a high minimum speed and low print costs. However, you'll most likely be limited to black-and-white printing at this price.

03 While you can still buy single-function laser printers, multi-function printers (MFPs) are now far more common. They can scan documents as well as print, and some of them also have fax capabilities. Laser MFPs start from around £200.

04 Heavy-duty office lasers can cost thousands of pounds. They use large individual toner drums, which can cut running costs. Automatic duplex (double-sided) printing is also common here.

05 Although laser printers are more suited to text than graphics, many are still able to produce high-quality photos. Speed isn't a priority here – instead choose a printer that reproduces subtle tones well. You can't determine this by looking at the specifications; only hands-on testing will do, so remember to check our reviews before you buy. Borderless printing (up to the edge of the paper) should also be possible.

06 If you want to print from multiple devices, make sure to look for extended connectivity. Decent laser printers can be shared on your local network, have USB ports for direct printing, memory card slots for printing images from a digital camera, and iOS, Android or Google Cloud Print support for printing from a mobile device such as a smartphone or tablet. An LCD preview screen offers greater control for this method of printing.

STORAGE

SSD	COMPUTER SHOPPER RECOMMENDED ★★★★★ CRUCIAL MX100 256GB £75 inc VAT • www.pixmania.co.uk The MX100 is quick for a budget SSD and the price makes the 256GB model fantastic value. 128GB and 512GB models are also available if you want to save money, or need more storage. CAPACITY 256GB • COST PER GIGABYTE £0.29 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE CT256MX100SSD1 • DETAILS uk.crucial.com • FULL REVIEW Apr 2015	
HARD DISK	COMPUTER SHOPPER BEST BUY ★★★★★ WESTERN DIGITAL Red 6TB £198 inc VAT • www.cclonline.com The Red 6TB combines excellent performance with a high capacity and special firmware, making a hard disk that's perfect for use in NAS enclosures. CAPACITY 6TB • COST PER GIGABYTE £0.03 • INTERFACE SATA3 • WARRANTY Three years RTB • PART CODE WD60EFRX • DETAILS www.wdc.com • FULL REVIEW Nov 2014	
NAS	COMPUTER SHOPPER BEST BUY ★★★★★ SYNOLOGY Diskstation DS215j £127 inc VAT • www.ebuyer.com Synology's latest NAS is faster than its predecessor thanks to an upgraded CPU, and is capable of rapid file transfers. DSM is still the best NAS operating system we've used, too. 3.5in HARD DISK BAYS (FREE) 2 (2) • NETWORKING 2x 10/100/1000 Ethernet • WARRANTY Two years RTB • PART CODE DS215j • DETAILS www.synology.com • FULL REVIEW Jun 2015	
PORTABLE SSD	COMPUTER SHOPPER BEST BUY ★★★★★ SAMSUNG T1 500GB £167 inc VAT • www.ebuyer.com The T1 is significantly faster than any USB3 flash drive as it has its own SSD controller. Combined with a USB3 connection, it's able to transfer files at unbelievable speeds – then slips into a pocket for taking on the move. CAPACITY 500GB • COST PER GIGABYTE £0.33 • INTERFACE USB3 • CLAIMED READ 450MB/s • CLAIMED WRITE 450MB/s • WARRANTY Three years RTB • PART CODE MU-PS500B/EU • DETAILS www.samsung.com/uk • FULL REVIEW Apr 2015	
PORTABLE HARD DISK	COMPUTER SHOPPER BEST BUY ★★★★★ WESTERN DIGITAL My Passport Ultra 1TB £50 inc VAT • www.dabs.com This compact 5,400rpm USB3 external hard disk comes with excellent backup and encryption software. We reviewed the 1TB model, which is a bargain, but for an extra £25 you can pick up the 2TB version. CAPACITY 1TB • COST PER GIGABYTE £0.05 • SPINDLE SPEED 5,400rpm • INTERFACES USB3 • DIMENSIONS 15x82x11mm • WARRANTY Three years RTB • PART CODE WDBZFP0010BBK • DETAILS www.wdc.com • FULL REVIEW Sep 2013	

PRINTERS AND SCANNERS

MONO LED PRINTER	COMPUTER SHOPPER BUSINESS BUY ★★★★★ RICOH SP 3600DN £169 inc VAT • www.ballicom.co.uk The SP 3600DN can print up to 50,000 pages per month at 30ppm. The quality is good, and each page costs only about 1.2p. It's a good choice for a busy small firm. TECHNOLOGY Mono LED • MAXIMUM PRINT RESOLUTION 1,200x1,200dpi • DIMENSIONS 268x370x392mm • WEIGHT 14.5kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY Two years RTB • DETAILS www.ricoh.co.uk • PART CODE 906231 • FULL REVIEW Oct 2015	
COLOUR LASER	COMPUTER SHOPPER BEST BUY ★★★★★ CANON i-SENSYS LBP7780Cx £413 inc VAT • www.nigelohara.com It's somewhat expensive to buy, but the Canon i-SENSYS LBP7780Cx is very cheap to run and produces impressively high-quality prints. TECHNOLOGY Single-pass colour laser • MAXIMUM PRINT RESOLUTION 600x600dpi • DIMENSIONS 401x517x530mm • WEIGHT 31kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS www.canon.co.uk • PART CODE 6140B010AA • FULL REVIEW Mar 2015	
INK JET MFP	COMPUTER SHOPPER BEST BUY ★★★★★ EPSON Expression Photo XP-760 £122 inc VAT • www.nigelohara.com It's not brilliant for printing office documents, but if you want great photos and brilliant scanning, Epson's good-looking and compact XP-760 is perfect. TECHNOLOGY Piezo inkjet • MAXIMUM PRINT RESOLUTION 5,760x1,440dpi • MAXIMUM OPTICAL SCAN RESOLUTION (OUTPUT BIT DEPTH) 2,400x4,800dpi (48-bit) • DIMENSIONS 141x390x341mm • WEIGHT 6.9kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.epson.co.uk • PART CODE C11CD96401 • FULL REVIEW Mar 2015	
INK JET MFP	COMPUTER SHOPPER BEST BUY ★★★★★ CANON Pixma MG6650 £78 inc VAT • www.amazon.co.uk This well-specified MFP isn't the fastest, but its print, copy and scan quality are superb. Improved touchscreen controls make it easier to use than some Pixmas, and its ink costs are reasonable too. TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 4,800x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 148x455x369mm • WEIGHT 6.4kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year RTB • DETAILS www.canon.co.uk • PART CODE 9539B008AA • FULL REVIEW Aug 2015	
OFFICE PRINTER	COMPUTER SHOPPER BEST BUY ★★★★★ HP Officejet Pro X476dw £325 inc VAT • www.ebuyer.com It may be an inkjet, but HP's MFP beats many colour lasers in terms of speed, print quality and running costs. TECHNOLOGY Thermal inkjet • MAXIMUM PRINT RESOLUTION 2,400x1,200dpi • SCANNER RESOLUTION 1,200x1,200dpi • DIMENSIONS 517x517x399mm • WEIGHT 24kg • MAXIMUM PAPER SIZE A4/legal • WARRANTY One year onsite • DETAILS www.hp.co.uk • PART CODE CN461A • FULL REVIEW Mar 2015	

Choosing a ...

Wireless router

01 Wireless routers conform to a number of standards, but you shouldn't have any trouble connecting your computer or phone wirelessly if you get an 802.11n or 802.11ac router. Nearly all routers support 802.11n, so even a cheap model should provide decent performance.

You can expect a transfer speed of around 40Mbit/s at 10m from any modern 802.11n router. The very latest routers use the incredibly fast 802.11ac standard, which provides tremendously fast transfer speeds. Few devices support the 802.11ac standard at the moment, but this situation will change over the coming months.

02 If you subscribe to an ADSL broadband service, you should buy a wireless router that has a built-in ADSL modem. This will cost more than the equivalent cable router, but it allows you to connect your router directly to your broadband connection without having to use a separate modem.

03 Most 802.11n wireless routers use the 2.4GHz frequency band. This has good range but can be prone to interference if it's positioned close to a lot of other 2.4GHz devices, such as other routers and baby monitors. If you have trouble getting a consistent signal or you want faster speeds for video streaming, it's worth buying a dual-band router that can use both the 2.4GHz and 5GHz bands.

Alternatively, a high-gain antenna can boost signals and improve ranges and throughputs to the entire house. You can also add a high-gain antenna to a PC's network adaptor. If wired network speeds are a priority, look for a router with Gigabit Ethernet.

04 Many routers come with built-in USB ports that let you connect a USB drive and use the router as a network storage device. If you want to share a USB printer over your network, look for a wireless router that has a USB print server.

Finally, if you're interested in making voice calls over the internet, buy a router with built-in VoIP support (and phone sockets) because this can save you money.

NETWORKS

COMPUTER SHOPPER **TP-LINK** Archer C9

BEST BUY ★★★★★

£100 inc VAT • www.argos.co.uk

It doesn't have a modem, so you'll need to pair it with your ISP's cable, ADSL or fibre modem, but the Archer C9 is an incredibly capable router with plenty of features and fantastic wireless performance.

WI-FI STANDARD 802.11ac • STATED SPEED 1,900Mbit/s • USB PORTS 1x USB3, 1x USB • LAN PORTS 4x Gigabit • WALL MOUNTABLE No • WARRANTY Three years RTB • PART CODE Archer C9 • DETAILS uk.tp-link.com • FULL REVIEW Sep 2015



COMPUTER SHOPPER **BT** Dual-Band Wi-Fi Extender 1200

RECOMMENDED ★★★★★

£50 inc VAT • www.shop.bt.com

This fast wireless extender is easy to set up and is the perfect companion to an 802.11ac router. The wired LAN port lets you connect a wired device to your wireless network, too.

WI-FI STANDARD 802.11ac • STATED SPEED 867Mbit/s • LAN PORTS 1x 10/100 • WARRANTY Three years RTB • PART CODE 80462 • DETAILS connectedhome.bt.com • FULL REVIEW Aug 2015



COMPUTER SHOPPER **DEVOLO** dLAN 1200+ Starter Kit

RECOMMENDED ★★★★★

£110 inc VAT • www.scan.co.uk

Devolvo's dLAN 1200+ is the fastest Powerline networking kit we've seen, even if you're limited to a single Gigabit Ethernet connection. The passthrough sockets are very convenient, too.

POWERLINE NETWORKING STANDARD HomePlug AV2 • STATED SPEED 1,200Mbit/s • ADAPTORS IN BOX 2 • WARRANTY Three years RTB • PART CODE 09378 • DETAILS www.devolo.com/uk • FULL REVIEW Feb 2015



COMPUTER SHOPPER **ASUS** EA-AC87

RECOMMENDED ★★★★★

£115 inc VAT • www.cclonline.com

It's much larger than the average range extender, but that's only to make room for a whopping five Gigabit Ethernet ports. The EA-AC87 can also act as a Wi-Fi access point.

MODEM None • WI-FI STANDARD 802.11ac • STATED SPEED 1,734Mbit/s • USB PORTS 0 • WALL MOUNTABLE Yes • LAN PORTS 5x Gigabit • WARRANTY Two years RTB • PART CODE 90IG01A0-BU9000 • DETAILS www.asus.com • FULL REVIEW Sep 2015



D-LINK DSL-3590L

★★★★★

£154 inc VAT • www.dabs.com

If you want to ditch your ISP-provided modem router, D-Link's DSL-3590L should be your first choice. It might not have the fastest Wi-Fi speeds but the feature list is impeccable.

MODEM ADSL2+ • WI-FI STANDARD 802.11ac • STATED SPEED 1,900Mbit/s • USB PORTS 1x USB3, 1x USB • LAN PORTS 4x Gigabit • WALL MOUNTABLE No • WARRANTY Two years RTB • PART CODE DSL-3590 • DETAILS www.dlink.com • FULL REVIEW Sep 2015



VIDEO

COMPUTER SHOPPER **AMAZON** Fire TV Stick

RECOMMENDED ★★★★★

£30 inc VAT • www.amazon.co.uk

The Amazon Fire TV Stick is a great inexpensive media-streaming device, which excels if you're an Amazon Prime subscriber. Even if you're not, you'll still get good mileage out of the Fire TV Stick through other platforms such as Plex. It's our new favourite discrete streaming device.

VIDEO OUTPUTS HDMI 1.4 • NETWORKING 802.11n • STREAMING FORMATS UPnP, AirPlay, DLNA • INTERNET STREAMING SERVICES iPlayer, Netflix, Sky News, Spotify, TuneIn Radio, Amazon Instant Video, TVPlayer • DIMENSIONS 115x15x17mm • WARRANTY One year RTB • PART CODE Fire TV Stick • DETAILS www.amazon.co.uk • FULL REVIEW Aug 2015



COMPUTER SHOPPER **GOPRO** Hero4 Black

RECOMMENDED ★★★★★

£280 inc VAT • www.simplyelectronics.net

The GoPro Hero4 Black doesn't deviate from the existing GoPro template but is an excellent action camera that introduces stunning 4K video at 30fps. You also get support for a wide range of mounts and accessories, meaning you'll be able to capture fantastic footage whatever the activity.

SENSOR 1/2.3in CMOS • SENSOR PIXELS 12,000,000 • MAX RECORDING RESOLUTION 4K (30fps) • AV CONNECTIONS Micro HDMI output, 3.5mm microphone to Mini USB (optional) • DIMENSIONS 41x59x30mm • WEIGHT 89g (152g with housing) • WARRANTY One year RTB • PART CODE CHDHX-4-1-EU • DETAILS www.gopro.com • FULL REVIEW May 2015



COMPUTER SHOPPER **CANON** Legria HF G30

BEST BUY ★★★★★

£857 inc VAT • www.nigelohara.com

This fantastic enthusiast camcorder has a capacitive touchscreen monitor, a great electronic viewfinder and a sensible array of function buttons. Its image quality is excellent, too.

OPTICAL ZOOM 20x • SENSOR 1/2.3in CMOS • LCD SCREEN 3 1/2in LCD, 1,230,000 dots • DIMENSIONS 84x189x182mm • WEIGHT 900g • WARRANTY One year RTB • PART CODE 84548009AA • DETAILS www.canon.co.uk • FULL REVIEW Sep 2015



COMPUTER SHOPPER **HAUPPAUGE** HD PVR Rocket

RECOMMENDED ★★★★★

£87 inc VAT • www.ebuyer.com

The HD PVR Rocket lets you record your gameplay from a PC or games console, including your own commentary. It's well designed, with a large red Record button and the ability to record directly to a USB drive.

WARRANTY Two years RTB • PART CODE 1527 • DETAILS www.hauppage.co.uk • FULL REVIEW Apr 2013



COMPUTER SHOPPER **PANASONIC** HC-WX970

RECOMMENDED ★★★★★

£650 inc VAT • www.photospecialist.co.uk

The Panasonic HC-WX970 is a twin-camera 4K-capable camcorder that lets you easily capture 8-megapixel stills from your 4K video. It has fantastic image stabilisation and its HDR video mode can help with exposing difficult scenes.

OPTICAL ZOOM 20x • SENSOR 1/2.3in BSI MOS • LCD SCREEN 3in, 460,800 dots • DIMENSIONS 73x65x139mm • WEIGHT 360g • WARRANTY One year RTB • DETAILS www.panasonic.com • PART CODE HC-WX970 • FULL REVIEW Sep 2015



WIRELESS ROUTER

WI-FI RANGE EXTENDER

POWERLINE KIT

WIRELESS BRIDGE

MODEM ROUTER

MEDIA-STREAMING STICK

ACTION CAM

CAMCORDER

GAMEPLAY RECORDER

CAMCORDER

Choosing a ... Graphics card

01 You really don't have to spend much to buy a decent graphics card that can drive multiple monitors. The AMD Radeon R7 250 costs less than £60, for example, and while it isn't suited to playing the latest games in Full HD, it is perfect for watching videos, browsing the web and playing basic games.

02 You'll need to spend more money if you want to play the latest games. A good mid-range gaming graphics card is the Nvidia GTX 960, which is powerful enough to play any of the latest games.

High-powered cards tend to be more expensive, so expect to pay over £300 if you want to play games in Ultra HD at the highest quality settings.

03 Check that your chosen card has the graphics outputs you need. Only low-end cards now have VGA outputs, but many come with a DVI-to-VGA adaptor. Depending on your monitor, you may also want an HDMI output or even DisplayPort.

Bear in mind that AMD's Eyefinity triple-monitor gaming mode requires at least one DisplayPort monitor, which means your AMD graphics card must have at least one DisplayPort output. Nvidia's Surround three-monitor mode needs only DVI and HDMI ports.

04 The amount of memory a card has is important if you want games to look their best at high resolutions. Get a card with 2GB of RAM at the very least, as this should allow you to select the highest-quality textures in games.






05 A card's size, noise output and power requirements are the final considerations. Make sure your PC's case has enough room to accommodate your chosen card. Double-slot cards with large fans tend to be quieter than single-slot cards with small fans but will block other expansion slots on your motherboard.

Also check that your power supply can provide the power the card needs and that it has the right connectors. Many cards require a six-pin PCI Express power connector, and some also need an additional eight-pin connector.

COMPONENTS

GRAPHICS CARD	COMPUTER SHOPPER RECOMMENDED ★★★★★ MSI GTX 960 Gaming 2G £164 inc VAT • www.scan.co.uk Nvidia's latest mid-range card is a fantastic performer at 1080p and will also play most titles at 1440p. It's whisper quiet too, switching its fans off completely when you aren't gaming. GPU Nvidia GeForce GTX 960 • MEMORY 2GB GDDR5 • GRAPHICS CARD LENGTH 367mm • WARRANTY Three years RTB • DETAILS www.msi.com • PART CODE GTX 960 GAMING 2G • FULL REVIEW May 2015	
	COMPUTER SHOPPER BEST BUY ★★★★★ INTEL Core i5-4690K £179 inc VAT • www.ebuyer.com The Core i5-4690K is a redesigned variant of the Core i5-4670K and runs at a faster speed out of the box but at lower temperatures. Coupled with its unlocked multiplier, this means the chip is ideal for overclocking. SOCKET LGA1150 • CORES 4 • FREQUENCY 3.5GHz • INTEGRATED GRAPHICS Intel HD Graphics 4600 • WARRANTY One year RTB • DETAILS www.intel.com • PART CODE BX80646I54690K • FULL REVIEW May 2015	
PROCESSOR	COMPUTER SHOPPER BEST BUY ★★★★★ AMD A10-7700K £87 inc VAT • www.scan.co.uk The A10-7700K strikes an excellent balance between desktop and graphics performance, making it the ideal all-rounder for an inexpensive PC build. SOCKET FM2 • CORES 4 • FREQUENCY 3.4GHz • INTEGRATED GRAPHICS AMD Radeon R7 • WARRANTY One year RTB • DETAILS www.amd.com • PART CODE AD770KXBJABOX • FULL REVIEW May 2015	
MOTHERBOARD	COMPUTER SHOPPER RECOMMENDED ★★★★★ ASUS Z97-E £99 inc VAT • www.dabs.com The Asus Z97-E is well priced for an LGA1150 motherboard, and automatic overclocking helps squeeze extra performance from your CPU with minimal effort. SOCKET LGA1150 • CHIPSET Intel Z97 • MEMORY SLOTS 4 • PCI-E x16 SLOTS 2 • PCI-E x1 SLOTS 3 • PCI SLOTS 2 • USB PORTS 2x USB, 4x USB3 • VIDEO OUTPUTS HDMI, DVI, VGA • DIMENSIONS 305x218mm • WARRANTY Three years RTB • DETAILS www.asus.com • PART CODE Z97-E • FULL REVIEW May 2015	
PC CASE	COMPUTER SHOPPER RECOMMENDED ★★★★★ SILVERSTONE Quiet Precision PS11 £37 inc VAT • www.scan.co.uk Well made and finished for the price, with plenty of sound-deadening features, the PS11 is the ideal starting point for a new PC build. The design might be a little plain, but we aren't complaining for £35. CASE TYPE ATX • MOTHERBOARD COMPATIBILITY ATX, microATX, Mini-ITX • SUPPLIED FANS 1x 120mm • MAX 3 1/2in DRIVE BAYS • MAX 5 1/2in DRIVE BAYS 2 • DIMENSIONS 215x482x427mm • WEIGHT 4.8kg • WARRANTY One year RTB • DETAILS www.silverstonetek.com • PART CODE SST-PS11B-Q • FULL REVIEW May 2015	

SOFTWARE

VIDEO EDITING	COMPUTER SHOPPER BEST BUY ★★★★★ ADOBE Premiere Elements 13 £63 inc VAT • www.adobe.com/uk Premiere Elements 13 offers a wealth of features to keep advanced video editors happy and has even more to help new users make the most of it. It's the best consumer video-editing package you can buy. OS SUPPORT Windows 7, 8 • MINIMUM CPU 2GHz with SSE2 • MINIMUM GPU DirectX 9 or 10 • MINIMUM RAM 2GB • HARD DISK SPACE 5GB • DETAILS www.adobe.com/uk • PRODUCT CODE 65234288 • FULL REVIEW Jan 2015	
	COMPUTER SHOPPER BEST BUY ★★★★★ SERIF PagePlus X8 £90 inc VAT • www.serif.com Get full control over the layout and appearance of your documents, from flyers to professional-looking publications. Version 8 adds a baseline grid, making text easier to line up, and improves photo editing. OS SUPPORT Windows XP or later • MINIMUM CPU Intel Pentium 4 or later, AMD Athlon 64 or later • MINIMUM GPU Not stated • MINIMUM RAM 512MB (Windows XP), 1GB (Vista, 32-bit Windows 7/8), 2GB (64-bit Windows 7/8) • HARD DISK SPACE 510MB • DETAILS www.serif.com/pageplus • PRODUCT CODE N/A • FULL REVIEW Feb 2015	
PHOTO EDITING	COMPUTER SHOPPER RECOMMENDED ★★★★★ ADOBE Photoshop Elements 13 £63 inc VAT • www.adobe.com/uk Elements may not have all the features of the full version of Photoshop, but it's still our favourite photo-editing package, and version 13 is the best yet, thanks to a new Guided mode for newcomers. OS SUPPORT Windows 7, 8 • MINIMUM CPU 1.6GHz with SSE2 • MINIMUM GPU DirectX 9 or 10 • MINIMUM RAM 2GB • HARD DISK SPACE 5GB • DETAILS www.adobe.com/uk • PRODUCT CODE 65237742 • FULL REVIEW Feb 2015	
GRAPHIC DESIGN	COMPUTER SHOPPER BEST BUY ★★★★★ SERIF Affinity Designer £40 inc VAT • affinity.serif.com/en-gb The first real competition to Adobe's Illustrator may be an OS X exclusive, but Affinity Designer is a seriously powerful graphic design tool that costs an incredibly reasonable £40. OS SUPPORT Apple OS X 10.7.5 • MINIMUM CPU Core 2 Duo (64-bit) • MINIMUM GPU Intel HD Graphics • MINIMUM RAM 1GB • HARD DISK SPACE 525MB • DETAILS affinity.serif.com • PRODUCT CODE Affinity Designer • FULL REVIEW Mar 2015	
MUSIC PRODUCTION	COMPUTER SHOPPER BEST BUY ★★★★★ STEINBERG Cubase Artist 8 £220 inc VAT • www.steinberg.net Music production software usually saves the best features for the priciest version, but that's not the case here, making Cubase Artist 8 an excellent investment for musicians aspiring to the highest standards. OS SUPPORT Windows 7 or later • MINIMUM CPU Intel Core/AMD dual-core • MINIMUM GPU DirectX 10 • MINIMUM RAM 4GB • HARD DISK SPACE 15GB • DETAILS www.steinberg.net • PRODUCT CODE 45550 • FULL REVIEW May 2015	

ON SALE NOW

MAGBOOK

**NEW
EDITION**
Create a killer
business
plan

START YOUR OWN **SUCCESSFUL** BUSINESS

START TODAY!

From finding the money
to developing your idea
into a sellable product

GROW TO SUCCEED

Find new customers, keep
them happy – and make sure you
expand at the right rate

KEEP MONEY ROLLING

Discover how to take
control of your cashflow
and ensure you get paid



**ONLY
£9.99**

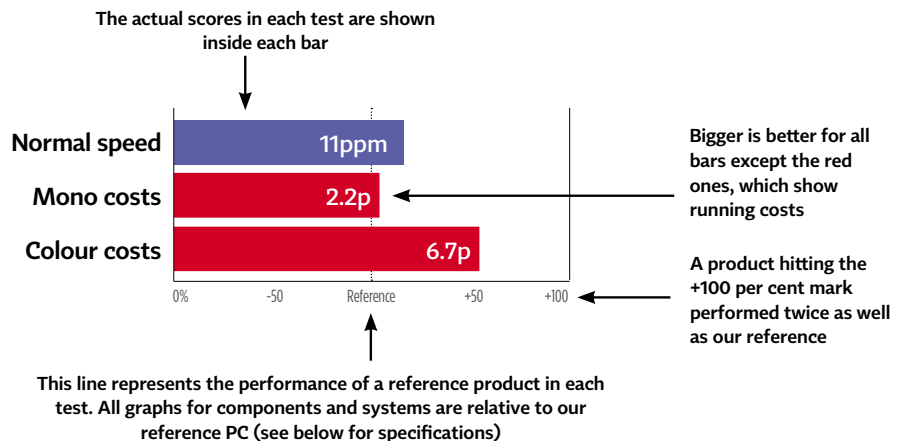
Order your print or digital
MagBook at **magbooks.com**

How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

COMPUTER SHOPPER'S REVIEWS use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the Reviews section, as shown on the right. Look in the 'Summary of tests' box (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See below for a brief description of our benchmarking software and game tests.



SUMMARY OF TESTS

PC SYSTEMS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications

Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail

LAPTOPS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Processor-intensive multitasking test
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
Battery life	Run time in minutes for continuous video playback

SMARTPHONES/TABLETS

Battery life	Run time in minutes for continuous video playback
--------------	---------------------------------------------------

PRINTERS AND MFPs

Mono text speed	Pages per minute for correspondence-quality text
Mixed colour speed	Pages per minute for presentable text and graphics
Mono page cost	Running costs expressed as pence per page
Colour page cost	Running costs expressed as pence per page

DIGITAL CAMERAS

Battery life	Number of shots from full charge
--------------	----------------------------------

CAMCORDERS

Battery life	Run time in minutes for recording
--------------	-----------------------------------

MP3 PLAYERS

Battery life	Run time in minutes for continuous playback
--------------	---------------------------------------------

ROUTERS

Laptop 24GHz 10m	Mbit/s at 10m with 802.11n laptop on 24GHz band
Laptop 24GHz 25m	Mbit/s at 25m with 802.11n laptop on 24GHz band
Laptop 5GHz 10m	Mbit/s at 10m with 802.11n laptop on 5GHz band
Laptop 5GHz 25m	Mbit/s at 25m with 802.11n laptop on 5GHz band
802.11ac adaptor 10m	Mbit/s at 10m with an 802.11ac adaptor
802.11ac adaptor 25m	Mbit/s at 25m with an 802.11ac adaptor

NETWORK-ATTACHED STORAGE

Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files

HARD DISKS

Extra large files	Average MB/s for read/write of a single 2.5GB file
Large files	Average MB/s for read/write of 2.5GB of large files
Small files	Average MB/s for read/write of 2.5GB of small files

PROCESSORS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

MOTHERBOARDS

Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail

GRAPHICS CARDS

Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4x MSAA, Ultra detail
Tomb Raider	Frames per second at 1,920x1,080, SSAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail

BENCHMARKS

SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, Mac OS X and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

We ran the tests on our reference PC, which has an Intel Core i5-4670K processor, 8GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a netbook, laptop or desktop, from both sections of the magazine.

To see how your computer compares, you can download the suite from www.shopperdownload.co.uk/benchmarks. Versions are available for 32-bit and 64-bit operating systems.

3D BENCHMARKS

DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll want at least 30fps for smooth racing.



TOMB RAIDER

With the ultra-demanding Super-Sampling Anti-Aliasing (SSAA) enabled, 2013's Tomb Raider reboot is a great indicator of mid-range performance.



METRO: LAST LIGHT REDUX

Our most demanding graphics test uses tessellation, SSAA and massive textures to give even high-end cards a thorough workout.



RATINGS & AWARDS

Computer Shopper rates products out of five:

Avoid	☆☆☆☆☆
Below average	☆☆☆☆☆
Good	☆☆☆☆☆
Very good	☆☆☆☆☆
Excellent	☆☆☆☆☆

The best products can win the following awards:

BEST BUY

Products with outstanding quality and performance for the money win our Best Buy award.



RECOMMENDED

Products that don't quite qualify for a Best Buy award but are still highly rated by our reviewers.



BUSINESS

The very best products for work win our Business Buy award.



Product Reviews

Our guide to all the products reviewed in this month's *Shopper*

104
Reviews

Hot Product 24

Intel Core i5-6600K

PCs & Laptops 26

Intel Compute Stick

HP Pavilion Mini

MSI GE62 2QE Apache

Scan 3XS Z170 Performance
GTK5

Windows 10 PCs 78

CCL Nebula 200i

Chillblast Fusion Gladiator

Cyberpower Ultra FX 100

Dino PC GS1

Mesh Elite Pro 10 CS

Palicomp Intel i5 Revolution

PC Specialist Fusion 311

Vibox Exile

Wired2Fire Diablo

Evolution

Yoyotech Warbird RS10

Handhelds 32

Acer Iconia One 8 B1-820

EE Harrier Tab

LG G4c

Vodafone Smart Ultra 6

Photography 38

Panasonic Lumix DMC-G7

Displays 39

Samsung U32E850R

Home Cinema 40

Epson EH-LS10000

Evolve Audio SB-2501

Samsung BD-J7500

Audio 46

Raumfeld One S

Video 48

EE 4GEE Action Cam

BT Ultra UHD YouView

Networks 50

Netgear Nighthawk EX7000

Printers and Scanners 52

Brother MFC-J5320DW

Canon Maxify MB5350

Epson WorkForce Pro

WF-5690DWF

HP Officejet Pro 6830

Storage 54

Toshiba Canvio Connect II

Western Digital My Cloud
EX2100

Components 56

Asus Z170-A

MSI Z170A Gaming M5

Software 60

Windows 10

Games 62

Trine 3

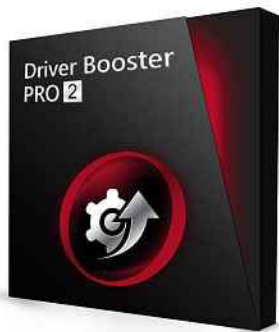
**SUBSCRIBE
AND SAVE**



**CALL 0844 844 0031
OR SEE PAGE 126**

Free software guide

Your free gifts are now even easier to enjoy. Just download all the software from www.shopperdownload.co.uk/333 and register with your unique coupon code

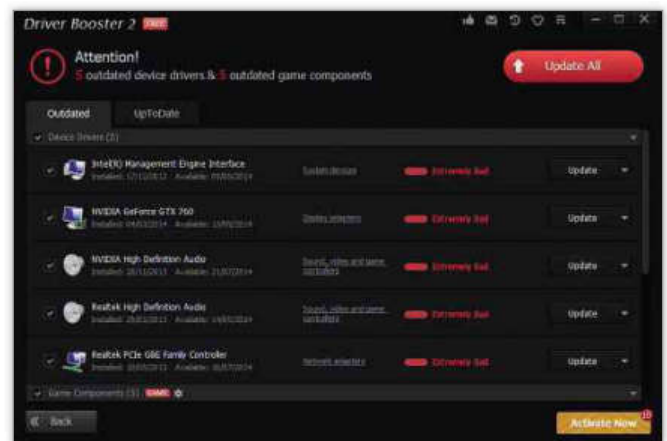


Driver Booster 2 Professional

IOBIT'S DRIVER BOOSTER is a simple and straightforward tool that can scan your system for outdated drivers, then download and install any updates with just a single click. If you upgrade to the Pro version after registration, you will gain additional features such as backup, faster download speeds and wider hardware support.

The program is incredibly easy to use. There's no complex interface and no searching around trying to decide what you need to do: just launch Driver Booster, it immediately scans your PC, and a detailed report appears just a few seconds later.

You can then click the 'Update' button individually for particular drivers, which is useful if you want to keep precise control over what's going on or, if you're in a hurry, just click 'Update All' and Driver Booster will download



and launch each update for you. Thanks to a silent update mechanism, you no longer have to wade through each and every driver update package manually, but do expect to reboot at the end of the process.

The application is incredibly simple to use, but more experienced users will find plenty of tweakable options available should they need them.

GETTING STARTED

The download instructions on the opposite page show you how to connect to the download site. Please make sure that you type in the web address exactly as shown. You'll need your coupon code the first time you log on.

ANY PROBLEMS

If you need help with any of the software this month, please send an email to letters@computershopper.co.uk. We check this inbox regularly. Please include the issue number of the magazine and your coupon code.

WHY DOWNLOADS

Software manufacturers have been requiring us to use online registration for some time now, but increasingly we're being asked to provide the program as a download. In order to continue bringing you the best free software, we've revamped our download site. You need to use the unique code printed in the box on the facing page to register and download the software in this issue.

The unique code means we stop the deals leaking online, so only Shopper readers get the software. You'll also enjoy a smoother registration, where we handle the registration process.

NO CODE?

If you don't have the card insert with the unique code, you must buy the £4.99 print version of the magazine. If you have bought this, please contact letters@computershopper.co.uk for help and a new code.

REQUIREMENTS Windows XP, Vista, 7, 8 or 10 32/64-bit,
30MB hard disk space
WEBSITE www.iobit.com
NOTES Get your registration code at db2.disc.computershopper.co.uk



WashAndGo 2015

THE MORE YOU use a PC, the more cluttered it becomes, weighed down by left-over 'temporary' files, orphaned Registry keys and a host of other junk. WashAndGo 2015 helps to reverse this process, restoring your system's original performance and stability. It goes beyond the usual basic steps, such as emptying the Recycle Bin and clearing your browsing history. Instead the program uses a deep knowledge of Windows and hundreds of applications to locate every surplus file and Registry key, giving your system a thorough clean.

WashAndGo 2015 analyses your system and reports on the results. This starts with the obvious junk, the Recycle Bin, crash dumps and temporary files. But the program also finds leftover files and Registry keys from Adobe Reader, IrfanView, iTunes, Word, Skype, uTorrent and VLC Media Player, as well as many megabytes of forgotten *.OLD and *.TMP files.

We're often suspicious of applications that ask to delete so much information. If they make a mistake, then there's no telling what might happen: in the worst case, you might cripple your PC. Fortunately WashAndGo 2015 allows you to stay in full control. If you view its report and decide that you don't want to clear any Java files, say, just clear the tickbox and they'll be left alone.

Unusually, the program will also by default back up any files it deletes, keeping them for two weeks. If WashAndGo 2015 does cause a problem for some reason, all you have to do is restore the backup.

WashAndGo 2015 can also run automatically, cleaning your system when Windows starts, once a day, or at some preferred schedule of your own. Once this is set up, there's no need to worry about system junk: WashAndGo handles it all in the background, while you get on with more important matters.

REQUIREMENTS Windows XP, Vista, 7, 8 or
8.1 32/64-bit, 40MB hard disk space
WEBSITE www.abelsoft.net
NOTES Get your registration code within
the application. Note if you have already
registered an Abelsoft application, you
won't need to register again

Chat and Communication

Digsby (Build 92) Access all your instant messaging services from one application; there's support for Windows Live!, Yahoo!, AIM, Google Talk, ICQ and Jabber.

Evernote 5.8 Store your notes, ideas and plans in the cloud, and synchronise them between computers.

Mozilla Thunderbird 38.1 A powerful email client from the organisation best known for the Firefox web browser.

Postbox Express 1.0 An email client that provides a comprehensive array of tools to help you manage your messages more easily.

UPDATED Skype for Windows 7.7 Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

Trillian 5.6 Use all your instant messaging accounts with one application; this program has support for Windows Live!, AIM, Yahoo! and Google Talk.



Customisation

7 Taskbar Tweaker 4.5 Customise the Windows 7 taskbar so that it works exactly to your liking.

Metro UI Tweaker for Windows 8 Tweak the Windows 8 user interface.

Mosaic Desktop Beta 1 Refresh Add Windows 8's mosaic-tiled desktop to your computer without having to upgrade.

Rainmeter 3.2 Customise the desktop quickly and easily with your choice of information, tools and shortcuts.

Windows 8 Transformation Pack 9.1 Emulate the look of Windows 8 on an earlier version of the operating system.

Windows 10 Transformation Pack 4.5 Bring some of Windows 10's new features to your current operating system.



General

Free Studio 6.5 This software provides an easy way to convert your video and audio files into different formats.

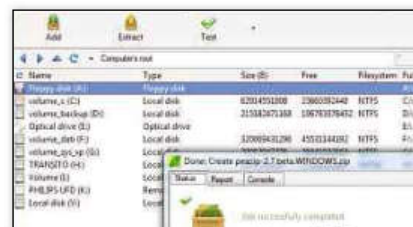
Paragon Partition Manager 14 Free Create, format, split, merge and reorganise all your hard disk's partitions.

UPDATED PeaZip 5.7 A tremendously powerful archive-management tool.

Screenshot Captor 4.1 Create and manage screenshots the easy way.

SUMo 4.0 Quickly scan your PC's installed applications and find any updates that are available for them.

ZipGenius 6.3 A flexible file-compression tool with support for a huge number of compressed file formats.



Internet and Network

CarotDAV 1.1

Manage all your online storage services with one simple application.

Cyberduck 4.7

A powerful but easy-to-use FTP client for uploading and downloading your files.

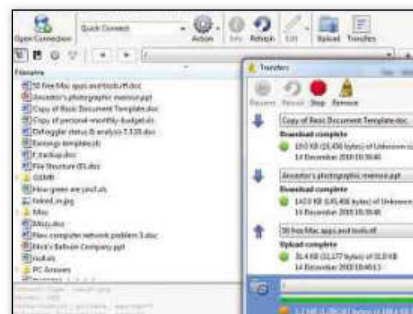
Easy WiFi 4.0

Find free Wi-Fi hotspots while you're out and about.

UPDATED NetBalancer 8.8 Make the most of your internet connection by assigning download and upload priorities to web applications.

TeamViewer 10.0 Remote-control your computer from anywhere in the world.

Vuze 5.6 A BitTorrent client to help you locate, share and download torrent files.



Tweaking and Performance

UPDATED CCleaner 5.08 Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

Defraggler 2.1 Ensure your system is defragmented properly and improve its performance.

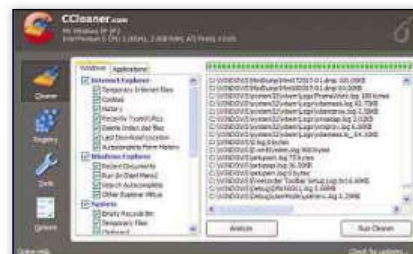
Finestra Virtual Desktops 2.5 Set up four or more virtual desktops on your PC.

IObit Advanced SystemCare 8.3

A complete computer security, maintenance and optimisation suite.

Revo Uninstaller Free 1.9 Remove installed applications completely, including all their folders, system files and Registry entries.

Simple Performance Boost 1.0 Tweak the Windows Registry to give your PC a performance boost.



Crafting PCs the Scan way: Specification. Service. Satisfaction.

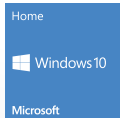


Scan V1 Value System Home / Office PC

- Intel® Pentium® G3240 processor
- 4GB Corsair DDR3 1333MHz memory
- 500GB SATA 6Gb/sec hard drive
- Windows 10

£299 Inc VAT

The V1 is a very capable entry-level system perfect from basic home/office tasks. It's based around the dual-core Intel® Pentium® G3240 processor, 4GB of RAM plus a 500GB hard disk.

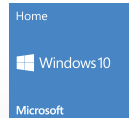


Scan V15 Value System Home / Office PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 1TB SATA 6Gb/sec hard drive
- Windows 10

£475 Inc VAT

The V15 ups the ante by including a quad-core Intel® Core™ i5 4460 processor, so it makes light work of office and multimedia applications.

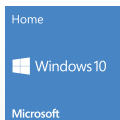


Scan G20 Value System Gaming PC

- Intel® Pentium® G3240 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 750 Ti SSC
- 1TB SATA 6Gb/sec hard drive
- Windows 10

£475 Inc VAT

Thanks to its dual-core Intel® Pentium® G3240 processor and NVIDIA GTX 750 Ti SSC graphics card the G20i is our most affordable gaming PC. It even includes surround sound!

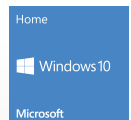


Scan G30i Value System Gaming PC

- Intel® Core™ i5 4460 processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 960 SSC ACX
- 1TB SATA 6Gb/sec hard drive
- Windows 10

£659 Inc VAT

The combination of quad-core Intel® Core™ i5 4460 processor and NVIDIA GeForce GTX 960 SSC ACX graphics card ensures that the G30i can play any game you throw at it.



Windows 10. Do great things.



Scan Value PCs

A range of computers perfectly suited for the home/office. These affordable PCs are very flexible workhorses, capable of every task, from email/web surfing to high-end applications such as photo editing, video encoding and gaming. All of our Value Systems are pre-built and soak-tested so are ready to ship for next-day delivery.



Finance Available on
PCs above £300



Built by award
winning 3XS team



Fully soak tested



Fully 3XS
compatible



Ready to ship



2 Year Warranty
Part + Labour



The most awarded PCs and Laptops Period.

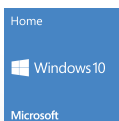


Scan 3XS Gamer 20i Gaming PC

- Intel® Core™ i7 4790 processor
- 8GB Corsair DDR3 2133MHz memory
- 4GB NVIDIA GeForce GTX 970 SC ACX
- 1TB Seagate HDD
- Windows 10
- 3 Year Premium Warranty

£999 Inc VAT

The 3XS Gamer 20i is a super-fast gaming PC thanks to its combination of quad-core Intel Core i7 4790 CPU running at 3.6GHz with added Hyper-Threading plus a 4GB NVIDIA GeForce GTX 970 graphics card. These components are installed in an Asus Z97-P motherboard along with a 1TB hard disk.

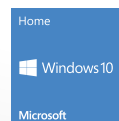


Scan 3XS Z170 Vengeance Gaming PC

- Intel® Core™ i7 6700K processor overclocked up to 4.6GHz
- 8GB Corsair DDR4 3000MHz memory
- 4GB NVIDIA GeForce GTX 980 SC
- 256GB Samsung PCIe SSD & 2TB HDD
- Windows 10
- 3 Year Premium Warranty

£1499 Inc VAT

This high-end gaming system includes a water-cooled Intel Core i7 6700K CPU overclocked up to 4.6GHz plus a 4GB NVIDIA GeForce GTX 980 graphics card, 8GB of 3000MHz Corsair Vengeance LPX DDR4 plus a 256GB PCI-E SSD for lightning quick gaming loading and a 2TB hard disk.

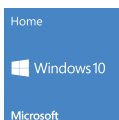


3XS Graphite LG157 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 2GB NVIDIA GeForce GTX 960M
- 15.6in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 10

£869 Inc VAT

The LG157 is a 15.6" mid-range gaming laptop that includes a NVIDIA GeForce GTX 960M graphics card plus an Intel Core i7 4720HQ CPU, up to 16GB of RAM and multiple hard disks and SSDs. The LG157 is ready for next-day delivery and is protected by a 2 Year Premium Warranty.

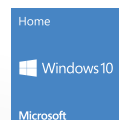


3XS Graphite LG1720 Gaming Laptop

- Intel® Core™ i7 4720HQ processor
- 8GB Corsair DDR3 1600MHz memory
- 3GB NVIDIA GeForce GTX 970M
- 17.3in 1,920 x 1,080 screen
- 1TB SATA 6Gb/sec hard drive
- Windows 10

£1075 Inc VAT

The LG1720 is a 17.3" high-end gaming laptop that includes a choice of powerful NVIDIA GeForce GTX 970M or 980M graphics card, ensuring silky smooth frame rates in all games. The LG1720 is ready for next-day delivery and has a 2 Year Warranty.



Scan Computers recommends Windows.

3XS Custom Series

Our 3XS Custom Series is a range of computers designed to offer the best performance for a variety of applications, with a particular focus on games. We build Custom Series PCs to order, so we can configure and tailor make an individual PC just the way you want it. We can also overclock the processor, so you get a faster PC without a substantial increase in price. All 3XS Custom Series PCs are covered by a three year warranty as standard with the first year on-site.



Scan 3XS Overclocked



Built by award winning 3XS team



3 Year Warranty

3XS SYSTEMS



WINDOWS 10 DESKTOP PCs

Windows 10 is here and it's great, so now is the perfect time to buy a shiny new PC to make the most of it. Here are 10 top systems for £600

CONTENT REVIEWS

Page 80

CCL Nebula 200i

Page 81

CHILLBLAST Fusion Gladiator

Page 82

CYBERPOWER Ultra FX 100

Page 83

DINO PC GS1

Page 84

MESH Elite Pro 10 CS

Page 85

PALICOMP Intel i5 Revolution

Page 86

PC SPECIALIST Fusion 311

Page 88

VIBOX Exile

Page 89

WIRED2FIRE Diablo Evolution

Page 90

YOYOTECH Warbird RS10

AS YOU CAN see from our Windows 10 review on page 60, we like Microsoft's new operating system. It's fast, well designed and great looking, and is essentially the OS Windows 8 should have been. So what better way is there to celebrate its release than to get new, super-powerful desktop PC that will really make Windows 10 shine?

This month we challenged our favourite UK system builders to create Windows 10 PCs for a budget of £600 – or just £700 with a keyboard, mouse and monitor. Before you turn the page and dive into the reviews, however, take a look at this buying guide, which will show you what to look for when buying a mid-range PC.



Intel recently released a new range of processors based on the latest Skylake architecture (see page 24). A couple of manufacturers sent us systems with these up-to-the-minute chips, and they're seriously fast. That's not to say the previous-generation Haswell processors aren't quick – far from it – and although it's always nice to see the latest hardware included, you need to consider that the manufacturers may have had to compromise on other components such as graphics cards or storage in order to accommodate pricier Skylake chips.

Many of the system builders have overclocked their processors, which gives the PCs a big performance boost. Overclocking isn't without consequences, though: for a start, it causes the chips to become hotter, which is why many of the systems have large processor coolers. Third-party coolers can often be quieter than stock models, however, due to their larger size and better-engineered fans.

CASE CLOSED

We're used to seeing midi-tower cases on PCs at this price, but you don't necessarily have to make do with bland black towers. A couple of this month's PCs have been built inside Mini-ITX cases, which are a stylish departure from the norm. Mini-ITX

cases are typically more compact than midi-tower models, although some have a larger footprint due to their cubed shape.

The compact size of a Mini-ITX case leaves less room for upgrades, so bear this in mind if you want to add lots of storage or upgrade a graphics card – most cases of this type don't have room for the most powerful cards.

TOOLS FOR THE JOB

You should expect to get a dedicated graphics card with a £600 PC, and all 10 of the systems on test are equipped with one. Dedicated graphics cards are much more powerful than any processor's integrated graphics chipset and a must if you want to play modern games.

Most of the system builders opted for Nvidia's GeForce GTX 960 graphics card. This is a great mid-range model that will play most games at 1,920x1,080 resolution and medium- to high-quality settings, and should last you for a few years.

A couple of manufacturers opted instead for the AMD Radeon R7 370, which isn't quite as powerful as Nvidia's card but is a little cheaper, leaving them with more money to spend elsewhere. Cyberpower's system, on the other hand, is equipped with the impressive Nvidia GeForce GTX 970, which eclipses the other cards on test and will handle practically anything you throw at it.

Even if you're not really planning to use your system for games, a dedicated graphics card improves performance in software applications that take advantage of GPU acceleration. These include image and video editing suites from Adobe, so while you should prioritise a faster processor, having a dedicated graphics card is still useful.

SAVE IT FOR LATER

Running out of storage space is always a pain, but all the systems we've tested come with at least 1TB of storage capacity. Several systems

are equipped with single mechanical hard disks, which provide lots of storage space for relatively little cash. A few have 1TB SSHD hybrid drives, which combine the inexpensive capacity of a mechanical hard disk with 8-24GB of SSD-grade NAND memory. This caches your most frequently used files, giving you some of the speed benefits of an SSD.

Two of the systems come with a pair of storage drives: an SSD for your operating system and software and a second, mechanical hard disk for storing all your media and documents. This is perhaps the best combination, as it gives you the fast bootup times and responsive Windows performance of an SSD plus the sheer capacity of a mechanical hard disk.

ADDED EXTRAS

We also asked the system builders to gather a selection of peripherals for each PC for a further £100. So for £700 you'll get a complete system with a monitor, keyboard and mouse – in other words, everything you need to get your PC up and running.

All the screens supplied have 1,920x1,080 resolutions, which is fine for Windows desktop work, although serious multitaskers should consider adding a second monitor. Most of the displays supplied are 24in, but a couple are a more compact 22in. Image quality between the screens varies significantly – we tested all the displays with our colour calibrator to get an idea of how accomplished they are at producing accurate, vibrant images.

PEACE OF MIND

Unfortunately, there's a chance that something will go wrong with any PC, so you'll be glad to have a decent warranty if the worst happens. The terms and duration of the warranty cover for each computer are listed in our table on page 92. Some manufacturers offer a collect and return warranty, which means they will pay the cost of shipping your PC back to their workshop and returning it to you once it's fixed.

Mini-ITX PC cases (below) are compact and look great, but offer far less room for expansion than a standard ATX chassis (left)



CCL Nebula 200i



£600 inc VAT (£700 inc VAT with monitor) •
From www.cclonline.com

VERDICT

The Nebula 200i's eye-catching case makes it stand out from the mid-range PC pack

A BUDGET OF £600 will get you a highly capable PC, but manufacturers still need to make some compromises to conform to what is a reasonably modest price bracket. One of the areas that often feels the pinch is the PC's case. We're used to seeing some solid but unexciting chassis in PCs at this price.

With that in mind we were pleased to see that CCL has made a slightly unusual choice for its Nebula 200i: the beautiful Xigmatek Nebula Mini-ITX case. This compact case is distinctly cube-shaped, which means it's both shorter and wider than your typical tower. You'll need to keep this in mind if you plan on placing the system on your desk, as it has quite a large footprint. The case is unusual in that it can take in air from its base from some delightfully quiet case fans.

The side panels are matt black with an attractive glossy finish on the top, and the case feels well made with quality materials. A cutout in the front bottom-left corner glows and blinks orange when the system is on, which could be distracting. There's no easy way to disable it either, although you can always disconnect it from the motherboard. Conveniently, the two side panels and front panel all pop off without the need for tools, so gaining access to the internals is a breeze.

EVENT HORIZON

Unsurprisingly considering the case's dimensions, the motherboard is mounted horizontally. The Nebula 200i uses an MSI H97I AC Mini-ITX motherboard, which doesn't



offer much scope for upgrades due to its small size. There's only one PCI-E x16 slot and this is occupied by the system's dedicated Nvidia GeForce GTX 960 graphics card. If you ever want to replace the graphics card in the future, bear in mind that the case only supports cards up to 200mm in length. That excludes most powerful models, but some manufacturers are producing mini versions specifically for this type of small case.

There's also a half-size Mini-PCI-E slot, but it's occupied by an 802.11ac Wi-Fi networking card. This means it's all set to connect to your wireless network, and the fact that the card uses the faster 802.11ac standard is a real bonus. We don't often see wireless cards included with PCs, so this is certainly a useful addition. There are no other PCI slots for upgrades such as dedicated sound cards, but most PCI cards have USB equivalents that do a similar job although aren't quite as neat.

The motherboard supports up to 16GB of memory and only one of the two slots is occupied by an 8GB DDR3 1,600MHz module. Adding another 8GB is a cheap and simple upgrade, and you'll benefit from a slight performance boost as the RAM will run in dual-channel mode.

Processing performance comes from a quad-core 3.2GHz Intel Core i5-4460, which, as a Haswell-based processor, is getting a little long in the tooth. An overall score of 83 in our application benchmarks shows it's still a respectable performer, though. The processor struggled most with the multitasking benchmark, which manipulates images while encoding and playing back 4K video, so a newer CPU is a better bet if you need high performance in such intensive tasks.

The system's gaming performance is also top-notch. The Nvidia GeForce GTX 960 graphics card managed an excellent 84fps in our Dirt Showdown benchmark at 1,920x1,080 with 4x anti-aliasing and Ultra quality settings. In Metro: Last Light at 1,920x1,080 with SSAA turned on and Very High quality we saw a just-playable 29.6fps, but turning off anti-aliasing lifted the frame rate to a much smoother 54.2fps. Considering the system's size, it packs a decent gaming punch.

You'll have plenty of space to install games, as the PC has a 1TB SSHD hybrid drive, which combines some of the speed benefits of NAND flash memory with the higher capacity of a mechanical hard disk. Windows 10 felt highly responsive on this PC. The drive's performance should improve as you use your PC, as it works out which files you use most often and stores them in its cache.

There are two USB3 ports and a headphone and microphone jack on the right side panel of the case. We'd have preferred these to be on the top of the case for ease of access. The back of the system has four more USB3 ports and two slower USB ports. You'll probably plug your keyboard and mouse into the normal USB ports, leaving you with four super-fast ports to play with. For audio it has connections for up to 7.1 surround speakers and an optical S/PDIF jack. The graphics card has two DVI ports, HDMI and DisplayPort so you can easily connect up multiple monitors.

The Nebula 200i is available with an Asus VE247T monitor for an extra £100. Its contrast ratio of 979:1 isn't particularly impressive, and its black levels of 0.31cd/m² don't help. However, the screen performed much better in our colour accuracy tests, covering 93% of the sRGB colour gamut.

KEY CONSIDERATIONS

If you buy the complete system, you get a wired Microsoft keyboard and mouse set. The mouse is basic but perfectly serviceable and comfortable to use. The keyboard's keys are a little spongy but we were able to type quickly and accurately. The keyboard doesn't have the smaller backspace key that plagues other cheap keyboards, and no keys are in strange places. The function keys along the top are small and fiddly, however.

The CCL Nebula 200i is a decent mid-range system. The case is delightful and the PC's combination of reasonable application and strong gaming performance makes it a great all-rounder in a tidy package. If you're after a small PC, though, the CCL is just pipped at the post by the Vibox Exile, thanks to its quicker processor. Those who are after a seriously powerful system with space for upgrades will be better off buying a larger PC, such as the Yoyotech Warbird RS10, however.



CHILLBLAST

Fusion Gladiator

COMPUTER
SHOPPER



RECOMMENDED £600 inc VAT (£700 inc VAT with monitor) • From www.chillblast.com

VERDICT

The Chillblast Fusion Gladiator's cutting-edge components make it seriously powerful

IF YOU'RE KEEN to have the latest PC components in your system, the Chillblast Fusion Gladiator should have your interest. Inside the case is a quad-core Intel Core i5-6600K processor based on the latest Skylake architecture. This is a follow-up to last year's Broadwell processors but is more of a refinement than a reinvention.

The processor has an unlocked multiplier, and Chillblast has overclocked it from its typical 3.5GHz speed to 4.4GHz, with an Akasa Nero 3 CPU cooler helping to control the resulting higher temperatures. The third-party cooler also has the added benefit of running incredibly quietly. Even under load it was barely louder than a whisper. It's quite large but doesn't obstruct the memory slots.

In our application benchmarks, the overclocked Skylake processor managed an overall score of 136, which is an excellent score. The processor will handle any task you might throw at it with aplomb. Its multitasking score of 140 was particularly pleasing.

The Chillblast Fusion Gladiator is housed in a Zalman Z3 ATX midi-tower case. It's a little taller than your average midi tower and has ridges down the sides and across the top, where you'll find two USB ports and a USB3 port. There's also a fan controller for toggling between low and high speed, but even with this set to high we couldn't hear the fans.

The PC is fitted with a 2GB AMD Radeon R7 370 graphics card. This lags behind the Nvidia GeForce GTX 960 for performance but



is still no slouch and certainly capable of running most games at medium to high graphics settings. Dirt Showdown didn't prove much of a challenge, with the card delivering 69.7fps at 1,920x1,080 with 4x anti-aliasing and Ultra graphics settings. Metro: Last Light was trickier, and we saw only 22.4fps at 1,920x1,080 with SSAA enabled and Very High graphics quality, which isn't smooth enough to be considered playable. Turn off anti-aliasing and the frame rate jumps to a more respectable 40fps, but this is still far behind the Nvidia GeForce GTX 960-based PCs.

SKY'S THE LIMIT

The Skylake processor sits in an Asus Z170-K motherboard with its new LGA1151 socket. Its four memory slots support 64GB of RAM. Two are occupied by two 4GB DDR4 2,133MHz memory modules. For storage it has a 1TB SSHD, which will leave you plenty of room for your applications, games and media. This hybrid drive's performance won't rival that of a dedicated SSD, but the built-in cache makes it significantly more responsive than a standard mechanical hard disk.

The PC has no optical drive, and with only one storage drive fitted, the motherboard has five remaining SATA3 ports for expansion. There's also a SATA Express port, but using this puts two of the SATA3 ports out of use. The M.2 port at mid-board lets you fit a super-compact M.2 SSD. These are generally more expensive than traditional SSDs but they make for a tidier build as they don't need to be connected to a SATA3 port on the motherboard or require a separate power cable from the PSU.

The motherboard also provides two PCI-E x16 slots, one of which is in use, and two PCI-E x1 slots, although one is obstructed by the dual-width graphics card. There are two PCI slots for further expansion. The case has four 3½in drive bays, one of which is

taken by the SSHD. There's a dedicated 2½in drive bay on top of the drive bay array for an SSD, two 5¼in external drive bays at the top and quiet 120mm fans at the front and rear. The system's 600W PSU will be able to power most upgrades you might consider.

PORT WORTH

At the front you get a USB3 and USB port, and there are two USB and two USB3.1 ports on the back. Interestingly, there's also a newer USB Type-C port. We expect to see many more USB Type-C devices in the future, so it's great to see it included here. We would have liked more USB3 ports, however. There are also two PS/2 ports for a keyboard and mouse and the usual Gigabit Ethernet. The graphics card has two DVI outputs as well as HDMI and DisplayPort for multiple displays.

For an extra £100 Chillblast will supply the Fusion Gladiator with an Acer 24in K242HL display and a keyboard and mouse set. The display has deep blacks, as shown by our colour calibrator's black level reading of 0.26cd/m². The screen's contrast ratio of 1,027:1 is also very respectable. Colour accuracy was good, with the monitor able to cover 94% of the sRGB colour gamut.

The Zalman ZM-K200M gaming keyboard proved a little frustrating to use, however. It has a tidy space-saving design and includes media and application shortcut keys, but its smaller backspace key proved irritating. The Zalman ZM-M300 mouse has good ergonomics, though, and we liked its rubberised coating.

The Chillblast Fusion Gladiator is a great system. Its Skylake processor gives it fantastic performance, and although this comes at the expense at some gaming power, it's a worthwhile trade-off if you need to run seriously intensive applications. The PC also has a great motherboard with plenty of upgrade potential. However, the Chillblast system is just pipped to our Best Buy award by the Yoyotech Warbird RS10, thanks to its more impressive gaming performance.



CYBERPOWER

Ultra FX 100



£600 inc VAT (£700 inc VAT with monitor) •
From www.cyberpowersystem.co.uk

VERDICT

Plenty of gaming punch but it comes at the expense of processing power

IF YOU HAVE £600 to spend on a gaming-specific PC, the Cyberpower Ultra FX 100 will pique your interest, thanks to its powerful 4GB Nvidia GeForce 970 graphics card. A card this powerful in a PC at this price is unusual, and most other current mid-range PCs have less powerful Nvidia GeForce GTX 960 or AMD Radeon R7 370 graphics cards.

Not surprisingly, gaming performance is the system's forte. It made light work of Dirt Showdown at 1,920x1,080 with 4x anti-aliasing and Ultra graphics detail, but its 72.4fps was less than we expected; we suspect the game was being held back by the processor. Metro: Last Light, however, was positively silky at 1,920x1,080 with SSAA turned on and Very High graphics settings. At these settings we saw 45.5fps, increasing to 71.7fps with the demanding super-sampled anti-aliasing turned off. It's here that you see the advantage of the GTX 970 over the GTX 960. The GTX 960 struggles to reach 30fps with SSAA turned on, so this is a significant improvement if gaming is a priority and will help you play demanding titles in the future.

Of course, skewing the system towards gaming has necessitated sacrifices elsewhere. The most obvious of these is Cyberpower's choice of processor. The Ultra FX 100 is equipped with only a quad-core AMD FX-4300 processor clocked at 3.8GHz. This processor didn't exactly set speed records when it was released back in 2012, and today its shortcomings are even more obvious.

In our application benchmarks, which involve demanding image manipulation and 4K video editing tasks, the Ultra FX 100 only



scored 47, which is poor for a mid-range desktop PC. Windows 10 still feels snappy, but this PC wouldn't be our choice for serious number-crunching. Multitasking performance in particular was poor, with a score of just 35.

The Ultra FX 100's Gigabyte GA-78LMT-USB3 motherboard offers reasonable scope for upgrades. It takes up to 32GB of memory across its four slots, and only two are occupied by a total of 8GB of DDR3 1,866MHz memory. There's just the one PCI-E x16 slot, and that's taken up by the sizeable GTX 970 graphics card. The dual-slot card also obstructs the motherboard's single PCI-E x1 slot, rendering it unusable. At least there's a single PCI slot remaining for an upgrade such as a high-specification sound card.

For storage the PC has a 1TB hard disk. We'd prefer it if at least an SSHD hybrid drive was included, but this is another area where sacrifices have been made. The motherboard has six SATA3 ports, though, and only one is in use, so it would be simple to add an SSD later if you want Windows to feel snappier.

The PC's Cooler Master N300 case has eight drive bays which can each take either a 3½in or 2½in disk, so you have all the upgrade space you could need. There are also two 5¼in external drive bays if you want to add an optical or Blu-ray drive – no optical drive is fitted as standard.

BOX STANDARD

The case itself is reasonably attractive as far as plain black midi tower cases go. It has nice clean lines and rounded corners, and a mesh grille covering the front. The power and reset buttons along the front edge are a little fiddly to press, but this is a minor inconvenience. There are two USB ports and one USB3 port in addition to headphone and microphone jacks on the front.

A 120mm intake fan is on the front of the case and a 120mm exhaust fan is on the back. Both fans, along with the graphics card's fan, are reasonably quiet. Sadly, the stock AMD cooler is far from silent. It emits a high-pitched whine that

picks up to even more audible levels when the system is under load.

On the rear there are four USB and two USB3 ports – we'd have liked more of the faster USB3 variety. Otherwise there is a PS/2 port for an older keyboard or mouse, Gigabit Ethernet and audio jacks for up to 5.1 audio; you could choose to use the three rear audio jacks in conjunction with the front jacks to plug in 7.1 speakers. The graphics card has two DVI ports, one HDMI and one DisplayPort output, so most monitor types are covered.

For £100 more, Cyberpower supplies the Ultra FX 100 with a 24in Acer K242HL monitor and a keyboard and mouse set. The display is reasonably plain, but has slim bezels and isn't particularly deep. There's no height adjustment, as we'd expect from a budget display, but you can tilt it easily enough and its stand doesn't have a big footprint. There are VGA and DVI connections.

BACK IN BLACK

Our monitor calibrator measured the display as having a decent 1,027:1 contrast ratio, as well as the ability to display 94% of the sRGB colour gamut, which is excellent for a budget display. Black levels were also suitably deep at a respectable 0.26cd/m².

The system comes with a better keyboard and mouse than we usually see. We're big fans of the Cooler Master CM Storm Devastator keyboard and mouse set. The keyboard's keys have plenty of travel and include useful volume and media controls. The mouse is a decent size with a nice rubberised surface and extra browser navigation buttons. You can adjust the mouse's sensitivity, too, allowing you to have different settings in games and on the Windows desktop. All in all, we were very impressed with the quality of the included peripherals.

The Cyberpower Ultra FX 100 is a great gaming PC with excellent peripherals. The inclusion of an Nvidia GeForce GTX 970 graphics card at this price is seriously impressive, but the PC's gaming performance comes at the expense of a relatively slow processor. If you're looking for a well-rounded system that's more future-proof, the Yoyotech Warbird RS10 is a better choice.



DINO PC GS1



£549 inc VAT (£700 inc VAT with monitor) •
From www.dinopc.com

VERDICT

A good-looking compact case and a great monitor, but its processor is underpowered

THE GS1'S COUGAR QBX case is one of the tidiest we've seen. Even as far as Mini-ITX cases go, it's pleasingly diminutive. The plain, angular design will appeal to those who appreciate clean lines and the system is small enough to plug in next to or under your TV. The case's materials are all good quality, too.

As we'd expect, Dino PC has had to make compromises due to the GS1's small case – this isn't the most powerful or upgradable system. Inside is a rather middling dual-core 3.2GHz Intel Pentium G3258 processor. When most other systems in this price range come with quad-core processors, we couldn't help but feel disappointed. The PC also has 8GB of 1,600MHz DDR3 installed in two modules.

Performance was as poor as we expected. In our desktop benchmarks it scored just 37 overall, which means the GS1 will be fine for everyday tasks such as web browsing or working through spreadsheets, but anything more intensive will involve waiting around. Not surprising for a CPU with two cores, the PC suffered most in the multitasking test, with a score of 20 bringing the average down.

The Mini-ITX Gigabyte GA-H97N-WIFI motherboard has limited upgrade potential. Its two memory slots are occupied, and the motherboard supports a maximum of just 16GB. At least it has six SATA3 ports. One of these is occupied by the system's 1TB hard disk, which provides plenty of space for your media but we couldn't help but wish the PC had been fitted with an SSHD hybrid drive to make the system more responsive.

The case's only 3½in drive bay is attached to a drive cage sited over the top of the motherboard. You'll need to remove this cage



to access the rest of the components. There are four 2½in drive bays for adding SSDs, but if you want to add an optical drive, you'll have to opt for a thinner slot-loading drive and fit it facing vertically so discs drop in from the top of the case.

The usual front-panel ports are actually located on the side of the case, which may be annoying. Here there are two fast USB3 ports as well as mic and headphone jacks. On the back you'll find four more USB3 ports and two USB ports. A PS/2 port is provided for a keyboard or mouse. For networking it has a

rather than the more common 16:9, and a larger 2,560-pixel horizontal resolution compared with the 1,920-wide monitors we usually see at this price. As the name implies, this means the display provides more horizontal screen space, which is useful for using programs side by side or for applications with long timelines, such as video editors. How much video editing you'll want to do with the system's disappointing processor is another question.

The monitor also helps give games a more cinematic, immersive view, but the extra pixels

The design will appeal to those who appreciate clean lines and the system is small enough to plug in next to your TV

Gigabit Ethernet port, and a Mini-PCI-E card for 802.11ac Wi-Fi and Bluetooth 4.0.

The single PCI-E x16 slot houses an Nvidia GeForce GTX 950 graphics card. This is Nvidia's newest card, but it's a budget model and can't rival the GeForce GTX 960 in other systems. It's a good card for the price, however, and will play most games you throw at it if you sacrifice some graphical fidelity.

In Dirt Showdown at 1,920x1,080 resolution, with 4x anti-aliasing and Ultra graphics settings, the PC managed 65.8fps, which is perfectly smooth. In Metro: Last Light Redux we saw 25.1fps at 1,920x1,080 resolution, with SSAA turned on and Very High quality settings. You'll need to turn off the super-sampled anti-aliasing to get enjoyable frame rates; after doing so we saw 44.6fps.

As a complete £700 system, the GS1 ships with a 25in LG UltraWide 25UM57 display. This differs from your typical widescreen display in that it has a 21:9 aspect ratio

put an added strain on the graphics card. When we switched to the monitor's native resolution in Metro: Last Light with SSAA turned off, we saw a frame rate of 35.3fps, which is lower than we saw at 1,920x1,080 but still very playable. In Dirt Showdown at the monitor's native resolution we saw 59.3fps, which is silky smooth.

Our image calibrator showed that the display is a fantastic choice for colour-sensitive work, too, covering 99.6% of the sRGB colour gamut. Its contrast ratio of 800:1 at default settings was disappointing, as were black levels at 0.3cd/m², but there are a multitude of image adjustment controls to get a more appealing image.

The complete system also comes with a Thermaltake Commander gaming keyboard and mouse. Both input devices give off a blue glow. The backlit keyboard uses plunger switches with mechanical keycaps, which give key presses a satisfying level of tactility. The mouse is comfortable in your hand and has on-the-fly adjustable sensitivity levels. It's a great-quality set overall.

The GS1 is available with excellent peripherals, and there are other things to admire about the PC – the case in particular is a high point. However, the underpowered processor drags the system down, leaving the Vibox Exile as our preferred Mini-ITX system. ➔



MESH Elite Pro 10 CS



£600 inc VAT (£700 inc VAT with monitor) •
From www.meshcomputers.co.uk

VERDICT

The Mesh Elite Pro 10 CS has a huge and slightly garish case, but its display is top-notch

THE MESH ELITE Pro 10 CS cuts an imposing figure in its AvP Venom case. The futuristic-looking design, complete with blue LEDs and glossy plastic, might not be to everyone's taste, but it's definitely striking. It's taller than most midi-towers and particularly curvy, even on the top. You won't be resting anything on this case unless you want it sliding off.

The glossy front panel is a door that hides the external 5¼in drive bays. The side panel has a large viewing window so you can see the internal components, and Mesh has neatly cabled the system with tubing to bundle all the loose cables together, making everything look neat. As such, airflow inside the case isn't a problem, aided by the 120mm exhaust fan in the back of the case. There's also space in the top of the case for a 240mm liquid processor cooler if you want to add one in the future.

The Elite Pro 10 CS uses a quad-core Intel Core i5-4690 clocked at 3.9GHz. This is based on Intel's 4th-generation Haswell architecture, so is no longer the newest technology. Still, it's more than capable for most desktop tasks, as our application benchmarks show. The PC scored 97 overall.

STICK SHIFT

The processor is paired with a single 8GB stick of 2,133MHz DDR3 memory. The MSI B85M-E45 motherboard supports up to 32GB across four slots, so upgrading the RAM is easy. Adding a second stick will also allow you to take advantage of dual-channel architecture, which improves performance.



The motherboard offers reasonable space for upgrades, but you won't be able to install a second graphics card as it has only one PCI-E x16 slot. There are two PCI-E x1 slots, although one is obstructed by the dual-slot Nvidia GeForce GTX 960 graphics card. A free PCI slot is provided for older expansion cards.

DRIVE IN SATA DAY

The PC has four SATA3 ports and two slower SATA2 ports. Two of the SATA3 ports have storage drives plugged in, and a SATA2 port is taken up with a DVD-RW optical drive. There are no M.2 or SATA Express ports for the latest generation of storage drives, but Mesh has included a 120GB SSD and a 1TB hard disk. We're always glad to see an SSD system drive, as these improve boot times and system responsiveness, while the 1TB hard disk provides plenty of storage space. If you're a serious gamer, the SSD may be too small for many of the latest blockbusters, though.

The case has plenty of spare drive bays for extra storage or a memory card reader. It has three 2½in drive bays, two of which are spare, and four 3½in bays with three spare. There are also three external 5¼in drive bays, only one of which is in use.

The Elite Pro 10 CS' Nvidia GeForce GTX 960 has 2GB of GDDR5 memory and performed as well as we expected. It's a proven mid-range card that can handle most of today's games at medium to high quality. Dirt Showdown isn't particularly taxing for a modern card, and the GTX 960 made light work of it, achieving a smooth 80fps at 1,920x1,080 resolution with 4x anti-aliasing and Ultra quality graphics. This is a few frames short of what we've seen from some GTX 960-equipped PCs, but Dirt tends to be held back by the processor at frame rates this high.

In Metro: Last Light we saw 28.7fps at 1,920x1,080 with SSAA turned on and Very High quality settings. You'll need to turn SSAA off

to achieve a smoother 52.6fps. The GTX 960 has two DVI outputs alongside HDMI and DisplayPort so you can easily set up a multimonitor configuration.

There's just one USB3 port on the front of the case, alongside two slower USB ports. This is supplemented by two USB3 ports and four USB ports on the rear. We like to see more of the faster ports on a modern PC. The back also has three audio jacks that can be used in combination with the front headphone and mic jacks for 7.1 audio. Gigabit Ethernet is provided for wired networking, and there's a pair of PS/2 connections for a legacy keyboard and mouse.

If you spend £100 more and order the Elite Pro 10 CS as a complete system, you'll receive a 22in Iiyama ProLite E2283HS-B1 monitor and a keyboard and mouse. We'd prefer a larger 24in display, as supplied with many other systems at this price, but what the monitor lacks in size it makes up for in image quality. Its contrast ratio of 1,233:1 is impressive, as are its 0.2cd/m² black levels. Our test images showed deep blacks and plenty of contrast. Images are fun and vibrant on this screen, but its below-average 86.9% coverage of the sRGB colour gamut shows it's not the most colour-accurate display.

The monitor is joined by a wired Logitech MK120 keyboard and mouse. This is a good budget set. The keyboard is comfortable to type on and has a good space-saving design without sacrificing comfort. There are no media or volume shortcut keys, however. The mouse is basic but comfortable to use.

The Mesh Elite Pro 10 CS is a well-built system with decent application performance and one of our favourite mid-range graphics cards. The display is on the small side, but we liked its high contrast ratio, and the inclusion of an SSD and hard disk is admirable. The Yoyotech Warbird RS10 and Chillblast Fusion Gladiator have the advantage for power, but if you want a good balance of application and gaming performance, along with the responsiveness that an SSD affords, the Elite Pro 10 CS is worth considering.

PALICOMP

Intel i5 Revolution



£600 inc VAT (£700 inc VAT with monitor) •
from www.palicom.co.uk

VERDICT

With an overclocked processor and graphics card, the Intel i5 Revolution ticks a lot of boxes

WE'RE STARTING TO see PCs with the latest Intel Skylake processors, but there's life in the old Haswell dog yet. Palicom has taken the time-honoured approach of using a Haswell processor and applying a substantial overclock for its Intel i5 Revolution.

We've seen the Zalman Z3 Plus case a number of times in other PCs – it's a popular mid-range choice. The Plus model used here differs from the standard case in that it has a viewing window built into the side panel. This gives you a glimpse of the components, although as the case's internal lighting only consists of a dull glow from the front 120mm case fan, there isn't much to see.

The case can be cooled either by a pair of 120mm fans or a 240mm water-cooling radiator at the top. Two 120mm fans are already fitted, so the PC doesn't want for cooling. Conveniently, there's a tray-like cutout on top of the case, which is just right for a phone or external hard disk plugged into one of the case's front USB3 or USB ports.

Inside the PC is an Intel Core i5-4690K. This is no longer the most cutting-edge processor available but it's still capable, especially when overclocked to 4.5GHz from its base clock of 3.5GHz and cooled with a Thermalright TrueSpirit cooler.

When put through its paces in our desktop application benchmarks, the processor helped the PC to an excellent score of 120. This isn't far behind Intel's newer Skylake-based



processors and shows that the Intel i5 Revolution is more than up to difficult processing tasks such as video transcoding. However, the PC can't quite match the multitasking performance of Wired2Fire's Diablo Evolution, which has the same processor and overclock, but twice the RAM.

Two free slots are available if you want to add more RAM, and the system's Asus Z97-P motherboard supports up to a maximum of 32GB. There are only four SATA3 ports, two of which are already in use by the 1TB hard disk and DVD-RW optical drive that come with the system. Depending on your upgrade plans, you might find this a little limiting. There is, however, an M.2 port if you want to fit a tiny M.2 SSD directly to the motherboard. It's a neat way to fit a fast system disk, which will help the PC feel much snappier in Windows.

FRAME COSTS

Graphics performance is provided by an Nvidia GeForce GTX 960 with 2GB of GDDR5 memory, which Palicom has overclocked. It produced frame rates above what we'd typically see from this popular mid-range card. In Dirt Showdown at 1,920x1,080 with 4x anti-aliasing and Ultra graphics settings, we saw a huge 91fps, which is about 10% better than this card typically manages at stock speeds.

Similarly, in Metro: Last Light, which is a much more graphically taxing game, we saw an average frame rate of 32.1fps at 1,920x1,080 resolution, with SSAA on and graphics set to Very High quality. This puts the game into smooth gameplay territory at these stratospheric settings. Turning off super-sampled anti-aliasing bumped this up to a silky 55.1fps, without adversely affecting image quality.

The front of the case has a single USB3 and two USB ports. We like to see at least a couple of

USB3 ports on a PC's front panel. There are four more USB3 ports and two USB2 ports on the rear, and the audio jacks at the back can be used in conjunction with the case's front headphone and microphone jacks to provide up to 7.1 surround sound.

PAT ON THE BACK

The rear panel also provides PS/2 ports for an older keyboard and mouse, and Gigabit Ethernet for fast wired networking. The Nvidia GeForce GTX 960 graphics card allows you to connect displays to its two DVI and HDMI and DisplayPort outputs.

Palicom will supply the Intel i5 Revolution with a keyboard and mouse set and a Samsung 24in LS24D300HS display for another £100. This attractive monitor has HDMI and VGA inputs and is suitable for colour-sensitive work thanks to its above-average 92.3% sRGB colour accuracy. A 955:1 contrast ratio and black level of 0.29cd/m² aren't quite as good as we would have liked, but they're more than respectable for a low-cost display. Viewing angles let the display down slightly, however. Onscreen images quickly gain a yellow tint if viewed off-centre.

The keyboard and mouse are unspectacular generic peripherals. The slim keyboard won't take up much space and has a plain design. There are no shortcut or macro buttons and the keys have a spongy action. At least the mouse has nicely contoured edges that help it fit well in your hand.

With an overclocked processor and graphics card, the Intel i5 Revolution provides great all-round power, and the full package includes a decent display. Those who want better application performance and the responsiveness of hybrid storage should consider the Chillblast Fusion Gladiator, however, while the Mesh Elite Pro 10 CS is worth a look if you want fast bootup speeds and application loading but don't want to scrim on gaming power. If you want the ultimate in application performance and gaming, though, the Yoyotech Warbird RS10 is the system for you.



PC SPECIALIST

Fusion 311



£600 inc VAT (£700 inc VAT with monitor) •
From www.pcspecialist.co.uk

VERDICT

Plenty of storage thanks to an SSD and hard disk, but its processor is below par

IF IT WEREN'T for the blue trim on the Cooler Master Elite 311 case, the PC Specialist Fusion 311 would look rather plain. The case is generally as unexciting as they come, which may suit you depending on your tastes – not everyone wants sharp angles or glowing LEDs, after all. The Elite 311's front panel is still a bit too much of a mix of textures and materials for our tastes, however.

The components aren't very exciting either. The Fusion 311 uses a quad-core Intel Core i5-4460 processor running at its standard 3.2GHz speed. This can Turbo Boost to 3.4GHz under the right thermal conditions, but even then its performance was nothing spectacular and the fan became rather loud.

The PC put in a reasonable rather than spectacular performance in our application benchmarks. An overall score of 81 is more than enough for day-to-day computing tasks, but it's far behind some of the powerhouses we've seen at this price. If you work with 4K video or want to leave an intensive task running in the background while you do something else, you may want to look for an overclocked system or one with a new Intel Skylake processor. The PC has only a single stick of 8GB DDR3 memory installed, so adding a second stick in dual-channel mode will help performance slightly.

A LITTLE BOARD

Oddly for a PC in an ATX case, the Fusion 311 uses a small microATX motherboard. The Asus H81M-Plus has two memory slots and

supports just 16GB RAM. It also has less upgrade potential than a full-size ATX board.

There are only four SATA ports, and only two of these run at 6GB/s. The other two operate at the slower 3GB/s, which would limit the speed of a modern SSD. The system may not have a particularly quick processor, but PC Specialist has been generous with its storage: the PC has a 240GB SSD for the operating system and a 1TB hard disk for your media. We're big fans of SSDs in PCs, as they make everything feel much more responsive. There's also a DVD-RW optical drive installed but this means you're left with just one SATA3 port for further upgrades.

The motherboard has only one PCI-E x16 slot for a graphics card, and it's occupied by an Nvidia GeForce GTX 960. It also has three PCI-E x1 slots for upgrades such as sound cards or TV tuners, although one is obscured by the dual-width graphics card, and expansion cards in the second might prove a tight fit too. The power supply is a relatively low-powered 450W Corsair VS450, but with limited scope for additional components this shouldn't be a problem.

The PC's Nvidia GeForce GTX 960 is a more than capable mid-range graphics card and had no problems with our Dirt Showdown

benchmark. At 1,920x1,080, with 4x anti-aliasing and Ultra graphics settings, we saw 77.4fps. This was slightly less than we saw from other PCs with this card, but at frame rates this high, processor speed also plays a part. In the far more challenging Metro: Last Light we saw 28.6fps at 1,920x1,080, with super-sampled anti-aliasing turned on and Very High quality settings, which is a fraction below what we would consider a playable frame rate. Turn off SSAA and you'll see 53.2fps, however. The graphics card will be fine for all modern games at this resolution, but you may need to knock graphics settings down a notch to be sure of absolutely smooth gameplay.

The front of the case offers a pair of USB ports but neither supports USB3, which was disappointing. We prefer to have faster USB ports available on the front of a PC, so we can quickly connect external storage devices or memory card readers. There are two USB3 ports on the back of the system and four more USB ports. You can connect multiple displays to the GTX 960 through its three DisplayPort and HDMI and DVI outputs.

For £700, the Fusion 311 is available as a complete system with a 24-in AOC E2470Sw monitor and a keyboard and mouse set. The monitor has DVI and VGA inputs and its bezels are matt plastic with a subtle brushed finish. It's an attractive enough display, with tilt adjustment and a sturdy stand. Our image quality tests showed the monitor to have a respectable 973:1 contrast ratio, which was helped by an impressive 0.23cd/m² black level. Our calibrator showed that it could only display a below-average 84.9% of the sRGB colour gamut, however, so it's not the best choice for manipulating photographs or performing other colour-sensitive work.

The keyboard and mouse set is a Cooler Master CM Storm Devastator kit, which is one of our favourite budget sets. The keyboard's keys have plenty of travel and well-judged feedback, so you can soon build up to a decent typing speed. It has media shortcut keys as well as volume, and the keys are backlit. The mouse is comfortable to use with browser navigation buttons on the side and three levels of adjustments so you can change the mouse's sensitivity for whatever you're doing with your PC.

SPACE STATION

Although having both a decent-sized SSD and a mechanical hard disk is commendable, PC Specialist's Fusion 311 is let down by its poor processor performance and a motherboard that has limited upgrade potential. The Yoyotech Warbird RS10 and Chillblast Fusion Gladiator are better all-round systems, and if you're not bothered about installing upgrades, the Vibox Exile justifies its lack of expansion options with its compact and elegant case.





MAGBOOK

Get the answers to all your Android questions



ON SALE NOW

ORDER YOUR MAGBOOK
AT AMAZON.CO.UK



VIBOX Exile

**COMPUTER
SHOPPER**

RECOMMENDED £600 inc VAT (£700 inc VAT with monitor) • From www.vibox.co.uk

VERDICT

The Vibox Exile has an excellent case but it comes at the expense of upgradability

IT'S EASY TO become a bit jaded when looking at mid-range PCs. Once you've seen one black midi-tower case, you've seen them all. So when the Vibox Exile showed up in a rather special Phanteks Enthoo Evolv ITX case, it was a nice change from the norm.

ITX cases have the advantage of being more compact and often more stylish than their midi-tower equivalents, but bear in mind that the corresponding Mini-ITX motherboard will have limited upgrade potential. The Enthoo Evolv ITX is certainly attractive and also extremely well built, with nice touches such as vibration-dampening screws and brackets. A small white LED built into the front panel glows subtly when the system is turned on and contrasts nicely with the case's matt black panels. There's also a large window built into the side panel, although you won't see a great deal as there's no illumination inside the case.

The window gives you a glimpse of the Raijintek Themis CPU cooler. This is a big heatsink but it doesn't have a noticeably negative effect on airflow in the PC. Cooling is aided by a massive 200mm fan fitted to the front of the case. Both the front and CPU cooler fans run quietly and the system remains whisper-quiet even under load.

Processing power comes from a quad-core 3.5GHz Intel Core i5-4690 processor. It's not the newest processor around, but its score of 99 is still strong for a mid-range PC. The Exile comes with 8GB of 1,600MHz DDR3 across two memory modules, but as the MSI H97I AC motherboard has only two memory slots,



you'll need to replace both modules if you want to upgrade. In any case, the motherboard supports a maximum of 16GB, so this PC won't be your first choice for a virtual machine-running powerhouse.

There's not much room for expansion elsewhere, either. The motherboard's only PCI-E x16 slot has a 2GB Nvidia GeForce GTX 960 installed. There are no PCI-E x1 or PCI slots, so adding any expansion cards such as a TV tuner internally will be out of the question.

Graphics performance from the PC's popular Nvidia GeForce GTX 960 graphics

drive bays, one of which is already in use by the SSHD. There are no 5¼in drive bays, so you don't have the option of installing an internal optical drive. If you use DVDs or CDs only occasionally, you can easily buy a USB DVD drive for less than £20.

There are two fast USB3 ports on the front of the case, as well as headphone and microphone jacks. Four more USB3 ports are provided on the back, along with two slower USB ports and a PS/2 port for an older keyboard or mouse. The MSI H97I AC motherboard comes with a dual-band 802.11ac

A small white LED built into the front panel glows subtly when the system is turned on and contrasts nicely with the case's matt black panels

card was as good as we expected. The Exile is a more than capable mid-range gaming system, and didn't break a sweat with Dirt Showdown at 1,920x1,080 with 4x anti-aliasing and Ultra graphics settings, producing 82.2fps. In Metro: Last Light it produced 28.8fps at 1,920x1,080 resolution with SSAA turned on and Very High quality graphics.

Turning off the hugely demanding super-sampled anti-aliasing led to a much smoother 52.5fps.

The motherboard has only four SATA3 ports, one of which is already occupied by a 1TB SSHD. The SSHD gives you all the storage of a mechanical hard disk with some of the speed of an SSD, thanks to 8GB of NAND memory, which caches the files you use most often and helps Windows feel more responsive.

Due to the case's small size and the motherboard's limited number of SATA3 ports, you won't be able to add a massive amount of internal storage. There's just one dedicated 2½in drive bay and two 3½

Mini-PCI-E Wi-Fi card installed, so it's ready for wireless networking right out of the box.

If you opt to spend another £100 for the complete system, the Vibox Exile comes with a keyboard and mouse set and a 22in Asus VS228HR display that has inputs for HDMI, DVI and VGA. We usually like to see 24in screens with modern PCs, but this is an impressive display. Our colour calibrator showed the monitor to be a great choice for performing colour-sensitive work, such as photo editing, as it displays an exemplary 95.7% of the sRGB colour gamut – a fantastic result for a budget monitor.

Also included is a Cooler Master CM Storm Devastator keyboard and mouse set, which is one of our favourite budget kits. The keyboard is incredibly comfortable to type on, and is only trumped by far more expensive mechanical models, while the mouse's adjustable DPI setting is handy for switching between games and the Windows desktop.

As long as you don't expect to make many drastic changes to your system in the future, the Vibox Exile is a great little system in a fantastic case. It has the edge over the CCL Nebula 200i, another Mini-ITX system, thanks to its faster processor performance and higher-quality peripherals.



WIRED2FIRE

Diablo Evolution



£600 inc VAT (£700 inc VAT with monitor) •
From www.wired2fire.co.uk

VERDICT

With strong desktop and moderate gaming performance, the Wired2Fire Diablo Evolution is a respectable all-rounder

THE DIABLO EVOLUTION is unusual among mid-range PCs in that it has an AMD graphics card rather than an Nvidia one. The AMD R7 370 isn't quite as quick as the current favourite among mid-range PCs – the Nvidia GeForce GTX 960 – but Wired2Fire has compensated for this by equipping its PC with a generous 16GB of RAM.

The PC's Raijintek Arcadia midi-tower case is unobtrusive, with embossed side panels. The largely plain front has a glossy mesh finish and hides a 120mm fan. Another 120mm fan is fitted to the back, and there's space for a pair of 120mm fans at the top of the case.

Its Intel Core i5-4690K processor is based on the Haswell architecture, which has just been superseded by Skylake. That's not to say it's slow, though. Wired2Fire has overclocked the unlocked CPU from 3.5GHz to a huge 4.4GHz. A Raijintek Themis CPU cooler keeps temperatures under control, and we were pleased to discover that its fan is nearly silent.

The processor is joined by a useful 16GB of 1,600MHz DDR3 memory spread across two 8GB sticks. This is more RAM than we typically see in systems at this price, and it proved its worth in our benchmarks. In the multitasking segment, where the PC has to manipulate large images while encoding and playing back 4K video, the PC managed a very strong 127, which is 10 points more than systems with the same processor and 8GB of RAM managed. The PC's overall score of 126 is excellent – you'd need a computer with one



of the very latest Intel Skylake processors to beat this PC's application benchmark score.

The system is based around an Asus Z97-P motherboard. This limits your upgrade options, as it has four only SATA3 ports. Two are already in use for a DVD-RW optical drive and a 1TB hard disk. This is ample storage, but we'd prefer at least an SSHD to help make Windows more responsive. You also have the option of installing an M.2-based SSD directly on the motherboard, which is a neat way of adding a super-fast system disk.

The front of the case has one USB3 and one USB port. At the back there are four more USB3 ports and two USB ports. These sit alongside a pair of PS/2 ports for an older keyboard and mouse, plus Gigabit Ethernet and three audio jacks, which you can pair with the front headphone and mic for 7.1 audio. The graphics card can output to multiple displays over DVI, HDMI and DisplayPort.

For an extra £100, the Diablo Evolution is supplied with input devices and a 24in Acer K242HL display. The screen has a reasonably

Wired2Fire has overclocked the unlocked Intel Core i5-4690K processor from 3.5GHz to a huge 4.4GHz

The motherboard has two PCI-E x16 slots but only one runs at x16 speed and is occupied by a 2GB AMD Radeon R7 370 graphics card. The second slot runs at x2 speed so is no good for adding a second graphics card. There are two PCI-E x1 and two PCI slots for further expansion, none of which is obstructed by the graphics card.

Performance from the R7 370 graphics card can't match that of the Nvidia GeForce GTX 960 we often see in mid-range systems at this price. In Dirt Showdown it produced 65.9fps at 1,920x1,080 resolution with 4x anti-aliasing and Ultra graphics settings. In Metro: Last Light we saw just 21.6fps at 1,920x1,080 resolution with SSAA on and Very High quality settings.

We had to turn off the demanding super-sampled anti-aliasing to achieve a playable 38fps in Metro, but even this is considerably off the pace set by the Nvidia GeForce GTX 960, so the Diablo Evolution isn't the best choice if gaming is a priority. If you're happy to decrease graphics quality for a smoother frame rate it will still handle modern titles.

thin glossy bezel and a tilt-adjustable stand with a small footprint. There are DVI and VGA connections on its back. Our test showed the panel to be of decent overall quality for a budget display, with a respectable 1,027:1 contrast ratio, 0.26cd/m² black levels and an impressive coverage of 94% of the sRGB colour gamut. Viewing angles were a little disappointing, however.

Although the monitor was of good quality, the same can't be said of the keyboard, which proved to be one of the most infuriating we've used. It's a generic plastic USB keyboard and is so light that it slides around your desk when you attempt to strike the frustratingly spongy keys. The backspace key is puzzlingly small, so you're likely to miss it more often than not, which is a problem as the keyboard proved difficult to use accurately. At least it has media and application shortcut keys across the top. The Zalman ZM-M401R mouse was more impressive, with four adjustable sensitivity settings and navigation shortcuts.

The Wired2Fire Diablo Evolution is a good all-round mid-range system. Its performance in desktop applications is great, and the PC can handle light to moderate gaming without too much trouble. It's slower than the Yoyotech Warbird RS10 and Chillblast Fusion Gladiator, however, and it's a shame the included keyboard is so poor.



YOYOTECH

Warbird RS10

COMPUTER
SHOPPER

★★★★★

BEST BUY

£600 inc VAT (£700 inc VAT with monitor) • From www.yoyotech.co.uk

VERDICT

The Skylake-powered Warbird RS10 provides huge all-round performance

THE NEWLY RELEASED Intel Core i5-6600K processor, based on the company's new Skylake architecture, has shown itself to be a more than capable overclocking candidate, thanks to its unlocked processor multiplier. We've seen manufacturers push it from its standard 3.5GHz clock speed all the way up to 4.4GHz after fitting a more robust cooler. The Yoyotech Warbird RS10 is just such a system, with an overclocked Skylake processor and suitably impressive performance.

In our application benchmarks, which involve manipulating large images and encoding and playing 4K video, the Warbird RS10 managed an excellent score of 137, which is what we'd expect from this processor at this speed. It's cooled by a SilentiumPC Spartan Pro CPU cooler, which runs quietly.

The system would be almost silent if it weren't for two 120mm fans mounted on the case's side panel – you'll need to detach these from the power supply before you can remove the panels. The side panel has an exposed grate without any sort of dust filter, and the vibrations of the fans create some noise, but it's not too distracting.

The processor is paired with 8GB of 2,400MHz DDR4 RAM split across two modules, and the PC's MSI Z170A PC Mate motherboard supports up to 64GB in its four slots. The motherboard has six SATA3 ports as well as an M.2 slot for a compact M.2 SSD, but using this will disable two SATA3 ports. One of the SATA3 ports is taken up by the system's 1TB hard disk. This is plenty of



storage for your files but we prefer an SSD system disk or hybrid drive in a PC at this price, as it makes Windows more responsive.

The case has lots of room for extra storage. As well as an additional three 3½in drive bays, it has a dedicated 2½in bay for an SSD. There are also three 5¼in drive bays, two of which are external for an optical drive or memory card reader. A 500W PSU is mounted at the top of the case.

The motherboard also provides expansion potential with its multitude of PCI slots. These include two PCI-E x16 slots – although the

As a complete £700 system the Warbird RS10 is supplied with a keyboard and mouse and an Iiyama ProLite E2283HS monitor. It's only a 22in panel, which is disappointing when most manufacturers supply 24in displays for systems at this price, and it's not the most exciting-looking display, either, with a matt bezel and plain tilt-adjustable stand.

What the screen lacks in size and glitz it makes up for with an excellent 1,233:1 contrast ratio and deep blacks, which we measured as a low 0.20cd/m². Its colour accuracy was only average, with the screen covering just 86.9%

The Warbird RS10 is a seriously fast PC with a high-spec motherboard and plenty of room for upgrades

second runs at x4 speed – three PCI-E x1 slots and two PCI slots. One PCI-E x1 slot is blocked by the system's dual-slot graphics card.

The Warbird RS10 gets its gaming power from an Nvidia GeForce GTX 960 with 2GB of GDDR5 memory. This capable mid-range card proved itself again in our gaming benchmarks. In Dirt Showdown at 1,920x1,080 with 4x anti-aliasing and Ultra graphics settings, it produced an excellent 84fps. In the more demanding Metro: Last Light, which we run at 1,920x1,080 with Very High quality settings and super-sampled anti-aliasing (SSAA), the graphics card produced 29fps, which is just shy of what we'd consider playable. Turning off the super-sampled aliasing will net you 50.5fps, which is easily enough for smooth gaming.

The front of the case has two USB3 ports and headphone and microphone jacks. There are six more USB3 ports at the back, so there's no shortage of places to plug in your super-fast USB devices. Gigabit Ethernet is available for wired networking, and there's a pair of PS/2 ports for older keyboards and mice.

of the sRGB colour gamut, so it's not the best choice for colour-accurate work such as photo editing. For any other task, such as watching films or playing games, it will do just fine.

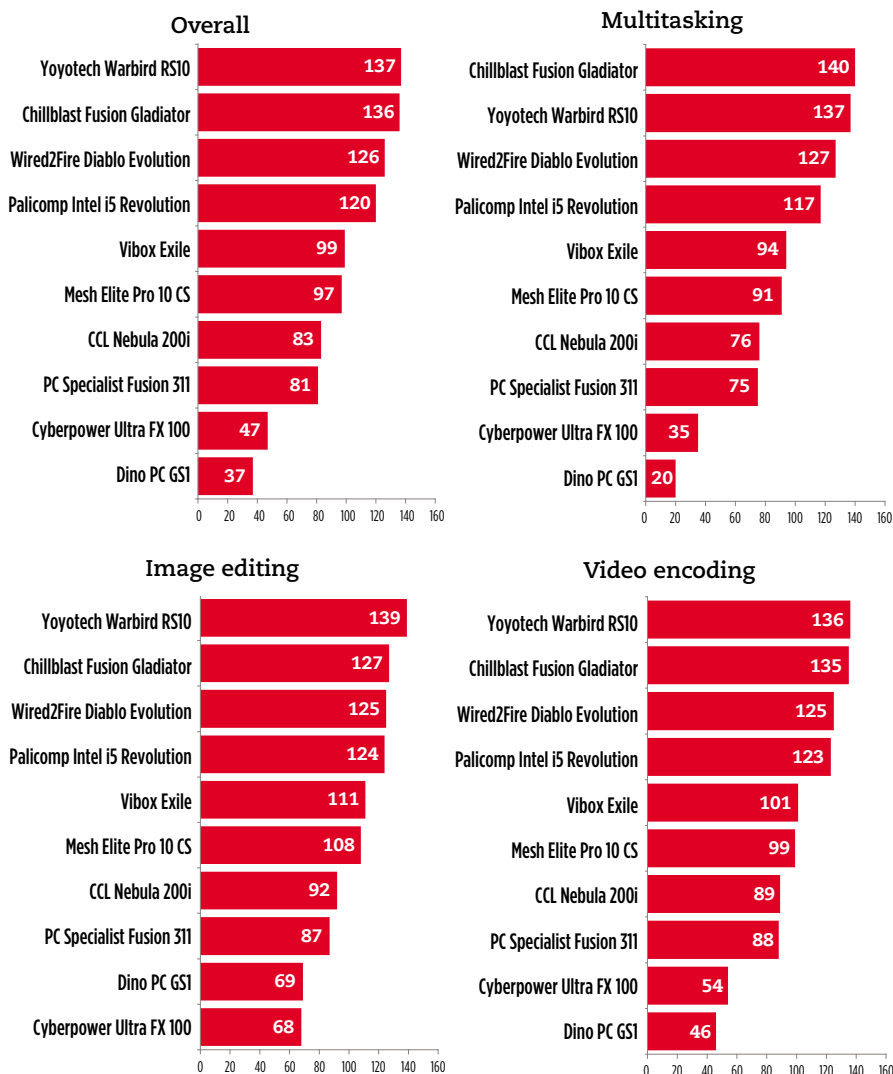
The supplied Zalman ZM-K350M keyboard is comfortable to type on, but you'll need to get used to its rather spongy keys. It's also an unorthodox shape, with sections that jut out, rather than a standard rectangular design. The spacebar has a pair of indentations where most users will typically strike the key. There are volume and media controls along the right side and shortcuts to useful applications such as the calculator on the left. The keyboard is paired with a Zalman ZM-M300 wired gaming mouse, which is equally comfortable to use and provides useful back and forward buttons, as well as a pair of programmable buttons for gaming macros.

The Yoyotech Warbird RS10 is a seriously fast PC with a high-specification motherboard and plenty of room for upgrades. Its only weak point is that it's limited to a simple mechanical hard disk, which means it lacks the snappiness in Windows that an SSD or hybrid drive can give you – as we saw with the Chillblast Fusion Gladiator. However, the Warbird provides an astonishing amount of performance in both applications and games, so it just beats the Chillblast system to an award. It's a Best Buy.



BENCHMARKS

2D performance



Our benchmark suite allows us to compare Windows, Mac OS X and Linux PCs. The tests use open-source applications to gauge a PC's performance, and comprise image-editing, video-editing and multitasking elements. These scores are combined to produce the overall score.

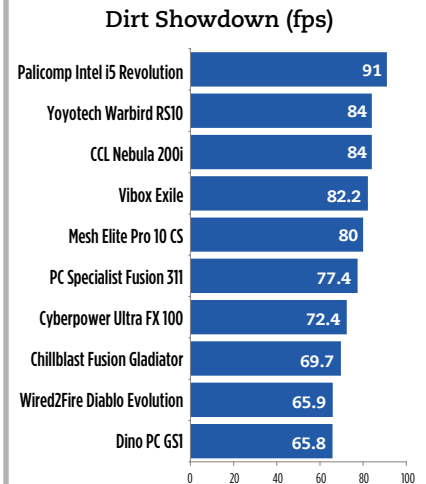
Our reference PC is fitted with an Intel Core i5-4670K processor and 8GB

of DDR3 RAM. We have normalised all its results to 100, which makes it easy to draw comparisons. We use the same tests in all our reviews.

You can download the tests for free from <http://bit.ly/shopperbenchmarks>.

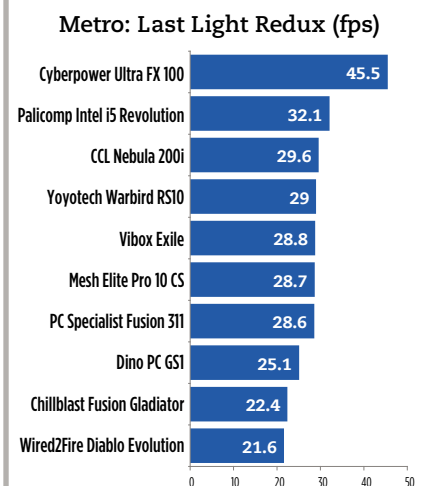
SETTINGS We run our application tests at native resolution
WEB <http://bit.ly/shopperbenchmarks>

3D performance



Dirt Showdown is a cracking racing game that requires relatively modest graphics hardware. We look for an average frame rate of 30fps to consider it playable.

SETTINGS 1,920x1,080 resolution, 4x AA, Ultra settings



Metro: Last Light Redux is a gorgeous game that will challenge all but the best graphics cards at maximum graphics settings. Its built-in benchmark will stress test a graphics card to its limits.

SETTINGS 1,920x1,080 resolution, SSAA on, Very High settings

VERDICT

This was a hotly contested group test, and it was tricky to choose between some of the fantastic PCs on offer. Some models did stand out, however, thanks to interesting designs or particularly strong performance.

Special mentions go to the Vibox Exile – which wins a Recommended award – and

CCL Nebula 200i, which both have attractive compact cases but less upgrade potential, and the Mesh Elite Pro 10 CS, with its powerful processor and graphics card and performance-enhancing SSD.

Our top two PCs are both powered by Intel's latest Skylake processors. Chillblast's

Fusion Gladiator has huge application performance and quick storage from its hybrid SSHD drive, but it can't quite match the competition in games. If you're after a PC that can do anything for a modest price, the hugely quick Yoyotech Warbird RS10 is the computer for you. It's a Best Buy.

CHILLBLAST
Fusion GladiatorVIBOX
ExileYOYOTECH
Warbird RS10

	RECOMMENDED				
	CCL	CHILLBLAST	CYBERPOWER	DINO PC	MESH
	Nebula 200i	Fusion Gladiator	Ultra FX 100	GS1	Elite Pro 10 CS
	★★★★☆	★★★★★	★★★★☆	★★★★☆	★★★★☆
COMPONENTS					
Processor	Quad-core 3.2GHz Intel Core i5-4460	Quad-core 4.4GHz Intel i5-6600K (overclocked)	Quad-core 3.8GHz AMD FX-4300	Dual-core 3.2GHz Intel Pentium G3258	Quad-core 3.9GHz Intel Core i5-4690
Processor socket	LGA1150	LGA1151	AM3+	LGA1150	LGA1150
RAM	8GB	8GB	8GB	8GB	8GB
Memory type	1,600MHz DDR3	2,133MHz DDR4	2,000MHz DDR3	1,600MHz DDR3	2,133MHz DDR3
Maximum memory	16GB	64GB	32GB	16GB	32GB
Motherboard	MSI H97I AC	Asus Z170-K	GA-78LMT-USB3	Gigabyte GA-H97N-WIFI	MSI B85M-E45
Motherboard chipset	Intel H97	Intel Z170	North Bridge: AMD 760G, South Bridge: AMD SB710	Intel H97	Intel B85
PORTS AND EXPANSION					
Front USB ports	2x USB3	1x USB3, 2x USB	1x USB3, 2x USB	2x USB3	1x USB3, 2x USB
Rear USB ports	4x USB3, 2x USB	2x USB3.1, 2x USB, 1x USB Type-C	2x USB3, 4x USB	4x USB3, 2x USB	2x USB3, 4x USB
Other ports	1x PS/2	1x PS/2	1x PS/2	1x PS/2	2x PS/2
Networking	1x 10/100/1,000, 802.11ac Wi-Fi	1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000, 802.11ac Wi-Fi, Bluetooth 4.0	1x 10/100/1,000
Case type	Mini tower	Midi tower	Midi tower	Mini-ITX	Midi tower
Case size (HxWxD)	330x260x260mm	430x192x430mm	426x190x492mm	291x178x384mm	504x190x490mm
PCI (free)	0 (0)	2 (2)	1 (1)	0 (0)	1 (1)
PCI-E x1 (free)	0 (0)	2 (1)	1 (0)	0 (0)	2 (1)
PCI-E x16 (free)	1 (0)	2 (1)	1 (0)	1 (0)	1 (0)
Serial ATA (free)	4x SATA3 (3)	6x SATA3 (5), 1x M.2 (1)	6x SATA3 (5)	6x SATA3 (5)	4x SATA3 (2), 2x SATA2 (1)
Memory slots (free)	2 (1)	4 (2)	4 (2)	2 (0)	4 (3)
Drive bays 2½in (free)	1 (1)	1 (1)	8 (7)	4 (4)	3 (2)
Drive bays 3½in (free)	1 (0)	4 (3)	8 (7)	1 (0)	4 (3)
Drive bays 5¼in (free)	0 (0)	3 (3)	2 (2)	1 (1) (slot loading-drive only)	3 (2)
STORAGE					
Total storage	1TB SSHD	1TB SSHD	1TB hard disk	1TB hard disk	120GB SSD, 1TB hard disk
Memory card reader	None	None	None	None	None
Optical drive type	None	None	None	None	DVD-RW
GRAPHICS					
Graphics card	2GB Nvidia GeForce GTX 960	2GB AMD Radeon R7 370	4GB Nvidia GeForce GTX 970	2GB Nvidia GeForce GTX 950	2GB Nvidia GeForce GTX 960
Graphics/video ports	2x DVI, HDMI, DisplayPort	2x DVI, HDMI, DisplayPort	2x DVI, HDMI, DisplayPort	2x DVI, HDMI, DisplayPort	2x DVI, HDMI, DisplayPort
SOUND					
Sound card	Realtek ALC892	Realtek ALC887	Realtek ALC887	Realtek ALC892	Realtek ALC887
Sound card outputs	Optical S/PDIF, 7.1 surround	5.1 surround	5.1 surround	Optical S/PDIF, 7.1 surround	5.1 surround
DISPLAY					
Monitor	24in Asus VE247T	24in Acer K242HL	24in Acer K242HL	25in LG UltraWide 25UM57	22in Iiyama ProLite E2283HS-B1
Native resolution	1,920x1,080	1,920x1,080	1,920x1,080	2,560x1,080	1,920x1,080
Inputs	DVI, VGA	DVI, VGA	DVI, VGA	2x HDMI	DVI, HDMI, VGA
OTHER HARDWARE					
Keyboard	Microsoft wired keyboard	Zalman ZM-K200M	Cooler Master CM Storm Devastator	Thermaltake Commander Gaming	Logitech MK120
Mouse	Microsoft wired mouse	Zalman ZM-M300	Cooler Master CM Storm Devastator	Thermaltake Commander Gaming	Logitech MK120
SOFTWARE					
Operating system	Windows 10 Home	Windows 10 Home	Windows 10 Home	Windows 10 Home	Windows 10 Home
Operating system restore option	Restore partition	Restore partition	Restore partition	Restore partition	Restore partition
BUYING INFORMATION					
Warranty	Three years collect and return	Two years collect and return with parts, three years labour-only RTB	Three years RTB (two years parts)	Three years RTB including one year parts	One year collect and return, two years parts cover, lifetime labour
Price including delivery (inc VAT)	£700	£700	£700	£700	£700
Price excluding monitor and keyboard/mouse (inc VAT and delivery)	£600	£600	£600	£549	£600
Supplier	www.cclonline.com	www.chillblast.com	www.cyberpowersystem.co.uk	www.dinopc.com	www.meshcomputers.com
Details	www.cclonline.com	www.chillblast.com	www.cyberpowersystem.co.uk	www.dinopc.com	www.meshcomputers.com
Part code	CCL-NEB-200if	Fusion Gladiator	Ultra FX 100	GS1	Elite Pro 10 CS

PALICOMP	PC SPECIALIST	RECOMMENDED VIBOX	WIRED2FIRE	BEST BUY YOYOTECH
Intel i5 Revolution ★★★★☆	Fusion 311 ★★★★☆	Exile ★★★★☆	Diablo Evolution ★★★★☆	Warbird RS10 ★★★★★
Quad-core 4.5GHz Intel Core i5-4690K (overclocked)	Quad-core 3.2GHz Intel Core i5-4460	Quad-core 3.5GHz Intel Core i5-4690	Quad-core 4.4GHz Intel Core i5-4690K (overclocked)	Quad-core 4.4GHz Intel Core i5-6600K (overclocked)
LGA1150	LGA1150	LGA1150	LGA1150	LGA1151
8GB	8GB	8GB	16GB	8GB
1,600MHz DDR3	1,600MHz DDR3	1,600MHz DDR3	1,600MHz DDR3	2,400MHz DDR4
32GB	16GB	16GB	32GB	64GB
Asus Z97-P	Asus H81M-Plus	MSI H97I AC	Asus Z97-P	MSI Z170A PC Mate
Intel Z97	Intel H81	Intel H97	Intel Z97	Intel Z170
1x USB3, 2x USB	2x USB	2x USB3	1x USB3, 1x USB	2x USB3
4x USB3, 2x USB	2x USB3, 4x USB	4x USB3, 2x USB	4x USB3, 2x USB	4x USB3, 2x USB3.1
2x PS/2	2x PS/2	1x PS/2	2x PS/2	2x PS/2
1x 10/100/1,000	1x 10/100/1,000	1x 10/100/1,000, 802.11ac Wi-Fi	1x 10/100/1,000	1x 10/100/1,000
Midi tower	Midi tower	Mini-ITX	Midi tower	Midi tower
465x192x430mm	450x190x477mm	375x230x395mm	430x200x455mm	175x400x415mm
2 (2)	0 (0)	0 (0)	2 (2)	2 (2)
2 (1)	1 (0)	0 (0)	2 (1)	3 (2)
2 (1)	3 (2)	1 (0)	2 (1)	2 (1)
4x SATA3 (2), 1x M.2 (1)	2x SATA3 (0), 2x SATA2 (1)	4x SATA3 (3)	4x SATA3 (2), 1x M.2 (1)	6x SATA3 (5), 1x M.2 (1)
4 (2)	2 (1)	2 (0)	4 (2)	4 (2)
1 (1)	0 (0)	1 (1)	2 (2)	1 (1)
4 (3)	5 (4)	2 (1)	4 (3)	4 (1)
2 (1)	3 (2)	0 (0)	2 (1)	2 (2)
1TB hard disk	240GB SSD, 1TB hard disk	1TB SSHD	1TB hard disk	1TB hard disk
None	None	None	None	None
DVD-RW	DVD-RW	None	DVD-RW	None
2GB Nvidia GeForce GTX 960	2GB Nvidia GeForce GTX 960	2GB Nvidia GeForce GTX 960	2GB AMD Radeon R7 370	2GB Nvidia GeForce GTX 960
2x DVI, HDMI, DisplayPort	DVI, HDMI, 3x DisplayPort	DVI, HDMI, 3x DisplayPort	DVI, HDMI, DisplayPort	2x DVI, HDMI, DisplayPort
Realtek ALC887	Realtek ALC887	Realtek ALC892	Realtek ALC887	Realtek ALC887
5.1 surround	5.1 surround	Optical S/PDIF, 7.1 surround	5.1 surround	5.1 surround
24in Samsung LS24D300HS	24in AOC E2470Sw	22in Asus VS228HR	24in Acer K242HL	22in Iiyama ProLite E2283HS
1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080	1,920x1,080
HDMI, VGA	DVI, VGA	DVI, HDMI, VGA	DVI, VGA	DVI, HDMI, VGA
Unbranded USB wired keyboard	Cooler Master CM Storm Devastator	Cooler Master CM Storm Devastator	Octigen JK0392DM	Zalman ZM-K350M
Unbranded USB wired mouse	Cooler Master CM Storm Devastator	Cooler Master CM Storm Devastator	Zalman ZM-M401R	Zalman ZM-M300
Windows 10 Home	Windows 10 Home	Windows 10 Home	Windows 10 Home	Windows 10 Home
Restore partition	Restore partition	Restore disk	Restore disc	Restore partition
Three years RTB	Three years RTB (one year parts cover)	Two years RTB, lifetime labour	Three years RTB (two years parts)	Three years (one year parts and labour RTB, two years labour RTB)
£700	£700	£700	£700	£700
£600	£600	£600	£600	£600
www.palicomp.co.uk	www.pcspecialist.co.uk	www.vibox.co.uk	www.wired2fire.co.uk	www.yoyotech.co.uk
www.palicomp.co.uk	www.pcspecialist.co.uk	www.vibox.co.uk	www.wired2fire.co.uk	www.yoyotech.co.uk
HAS12	Fusion 311	Exile	Diablo Evolution	ER0815WRS10

Windows 10 vs Windows 8: which is faster?

On a powerful, modern PC, Windows 10 is just as quick as Windows 8. But will your older Windows computer cope with the new OS after an upgrade? We find out

THE FACT THAT Windows 10 is free for Windows 7 and 8 users is great, but there's always the worry that a new operating system will make your computer grind to a halt (Vista, anyone?). If you're concerned your PC will slow down after upgrading to Windows 10, read on; this article will help those with less-powerful systems decide whether to upgrade.

We've run the *Computer Shopper* benchmarks on some older Windows 8 laptops to see if upgrading to Windows 10 affects their performance, if the new OS will increase your RAM usage, and if boot times are better or worse under the new OS.

Performance and upgrades

Windows 10 has the same minimum requirements as Windows 7 and 8 (see below). If you already have a computer that shipped with either Windows 7 or 8, you'll be able to run the new operating system.

WINDOWS 10 MINIMUM REQUIREMENTS	
Processor	1GHz or faster
RAM	1GB (32-bit) or 2GB (64-bit)
Disk space	16GB (32-bit) or 20GB (64-bit)
Graphics card	Microsoft DirectX 9-compatible

However, if you have an old netbook running Windows 7 Starter, it may struggle to run Windows 10 smoothly. As a very rough rule, we'd say you want a minimum of a 2GHz dual-core CPU, plus 4GB of RAM. This is only a guide, though, as some new mobile chips run at speeds lower than 2GHz, but can boost to higher speeds when they need to. Again, the rule of thumb is that if your computer runs Windows 7 or Windows 8 well, Windows 10 should be fine; if your computer is struggling a little now, don't upgrade. Our benchmarks back up this supposition, too.

When testing, we wanted to use computers that were more likely to struggle under a new operating system; when we ran the *Shopper* benchmarks on high-performance desktops, there was no difference between Windows 8.1 and Windows 10. For this reason we gathered low-end machines for testing. The standard *Shopper* benchmarks, which deal heavily with 4K video, are too demanding for low-powered computers, so we used our previous 1080p benchmarks instead. These test a computer's performance in image editing, video editing and multitasking, where large images are manipulated, Full HD video is transcoded and Full HD video is played back, all at the same time.

The first laptop is a Dell Inspiron 17 from 2013, which has a 1.8GHz Intel Core i5-3337U processor and an AMD Radeon HD 7600M graphics chip. This machine has been well used, so is loaded with programs and files already, which makes it a realistic example of a laptop that's being upgraded to Windows 10 in situ. The laptop originally shipped with Windows 8 but has since been upgraded to Windows 8.1.

The second machine is an Acer Aspire V5 from 2013, which has a dual-core AMD C-70 running at 1GHz. This laptop was slow in 2013 and feels even slower today. It originally shipped with Windows 8. Our final laptop is a more contemporary model from Acer, but still a low-end device. It's an Aspire E111 from 2014 with an Intel Celeron processor on board and Windows 8.1. We ran all our tests on each device with its original operating system, and then performed a direct upgrade to Windows 10. You'll find the results on the right.

Verdict

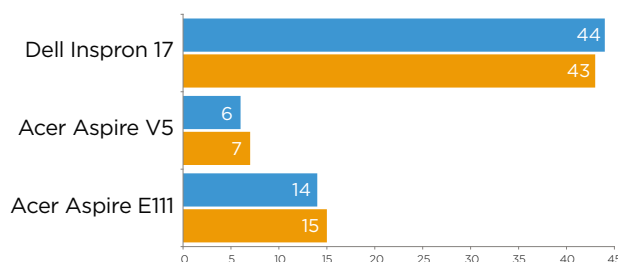
If your PC is fine running its current operating system, Windows 10 has no impact on performance or the amount of RAM used. However, boot times can be affected if your computer suffers from the bootup bug; see our 'Windows 10 Fixed' feature on page 96 for details. **CS**

Windows performance

Windows 10
Windows 8/8.1

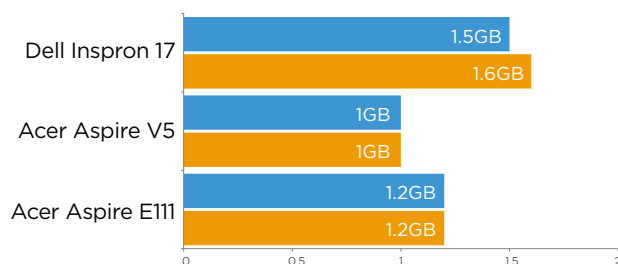
Shopper benchmarks

Our *Shopper* benchmarks rely heavily on the processor. Each laptop scored the same or nearly the same in every test in both Windows 8/8.1 and Windows 10. Any small changes in scores are within statistical variance, showing the upgrade has no performance impact in these intensive application tests.



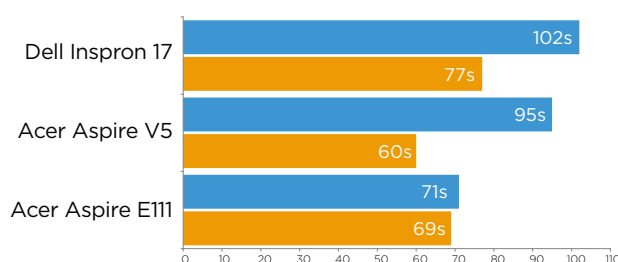
RAM

The amount of RAM occupied by Windows will affect how many programs you can open at a time, and also your multitasking performance. To ensure comparable results, we switched on each laptop and left it for five minutes to make sure all startup processes had finished. The results show Windows 10 doesn't appear to use more or less RAM than Windows 8; it merely fills as much of the RAM as it can without affecting system performance in other areas, much like Windows 8.



Boot times

With the Dell laptop, under Windows 10 bootup took a huge 25 seconds longer, and the Acer V5's boot time also shot up after the upgrade. This confirms problems reported online, where users find themselves trapped in a black screen for some minutes before the Windows 10 login screen appears.



Ask Alison



Got a tech problem that's driving you mad? Alison has the answers!

Ronald from Derby:

Q I'm always forgetting to copy photos of my trekking holidays on to my smartphone – my mates think I just lounge on beaches! Is there a way to send them to my phone automatically?



Alison says:

Use Qsync to synchronise photos automatically from your PC to your QNAP Turbo NAS TS-451 – you can then install myQNAPcloud to access these photos from anywhere you have an internet connection. As you're just remotely viewing these photos from your Turbo NAS, you don't even have to worry about your phone's storage limit.

You can create your own personal cloud by installing myQNAPcloud and using the Auto Router Configuration tool. Now install Qsync on your QNAP Turbo NAS and on your Windows or Mac computer; once your Turbo NAS has been found, tell this application to synchronise your photos folder. Access your photos on your phone via the Qphoto app (free for Android and iOS) or any web browser.

Robert from Chester:

Q I've got loads of presentations and important files stored on my two laptops and my desktop but I can never remember which machine has what stored on it. I can never find

these files when clients or colleagues ask for them – I must look very unprofessional! Is there an easy way to sort this out?



Alison says:

Yes, a very easy way! Use Qsync to automatically synchronise your files to your Turbo NAS TS-451, or save your work directly to the Turbo NAS. Once myQNAPcloud is set up, you can share files on your Turbo NAS with clients or workmates via the File Station's Share button, via a web browser or with the Qfile app on your mobile devices. As your Turbo NAS acts like an FTP and email server, you can email files, upload them to social media or send a link to download files.

Felicity from Kendal:

Q I need a simple and small computer to check things online but I don't want to spend loads on a new laptop or tablet.



Alison says:

You don't need a new device at all, just plug a mouse and keyboard into your QNAP Turbo NAS TS-451 and connect it to your TV via HDMI. QNAP's QvPC technology allows you to launch Chrome or Firefox to



browse the internet, or even run Spotify. As a bonus, you can now also use HD Station to enjoy videos on your Turbo NAS in Full HD on your TV!

Harry from Elgin:

Q My work wants me to take a laptop on the road just to use their accounting software, but I don't want to carry the heavy thing around with me, or be liable for its loss or damage. Can I avoid back strain and risk?



Alison says:

Using QvPC technology you can create a virtual machine on your QNAP Turbo NAS TS-451 to replicate the function of that bulky laptop. Connect the Turbo NAS to your router via both supplied Ethernet cables and install Virtualization Station. Create a new 'VM' (virtual machine) from the VM Management panel, choosing 'Medium' as its size. Name your new virtual machine – 'Work Accounts', for example – and use a downloaded ISO file of the necessary operating system as the CD Image. Click Create, then Start and then Console and you can set up your new virtual machine exactly as you would an actual machine. You'll be able to access your new virtual machine from anywhere you have internet access thanks to QNAP's myQNAPcloud technology.

Travel worries solved!

Many of your letters this month complained about leaving a vital file at home, whether it was a video you wanted to show a relative or a presentation for a crucial meeting. There's a range of free QNAP apps to solve this problem. Qfile (free for iOS and Android) can access every file on your Turbo NAS, and you can even share these files with others from within the app. Use specific apps for photos (Qphoto), video (Qvideo) and music (Qmusic).

Other readers fretted about their homes and technology while they were away. Thankfully QNAP can allay these fears, too. Use the free Qmanager app to control your Turbo NAS from anywhere in the world. To ensure all is safe at home, use Vmobile to access your security cameras. With these free apps you can enjoy your travels, whether they're for a holiday or an important conference.





Windows 10

Privacy, performance, licensing and more



Last month we took you through all the new features of Windows 10. This month we dig a little deeper, with performance optimisations and fixes for common problems

ALTHOUGH OUR IN-DEPTH guide to Windows 10 (see *Shopper* 332) brought you everything you needed to know about getting started with Microsoft's latest operating system, we couldn't quite cover everything. In particular, as our issue went to the printers a couple of days after the final version of the operating system was released, we knew that issues would arise after we had gone to press that would need addressing in a future edition of *Computer Shopper*.

That's where this feature comes in. Over the next eight pages we'll address some burning questions about Windows 10. We'll help to clear up some licensing confusion, help fix some of the installation and performance problems users have found, show you how to tweak the OS to your liking

and address some concerns about Windows 10's privacy settings.

Finally, if you've tried Windows 10 and have decided it's not for you, we show you how to downgrade back to your previous operating system.

LICENSING QUESTIONS ANSWERED

One of the big issues we had with Microsoft's free upgrade offer was that the company never bothered to explain how it would work. Now that the OS is out, we've discovered a few things that every upgrader needs to know. Don't worry, the upgrade instructions that we gave last month still work perfectly; it's just that the extra information we now have cleans up some of the mysteries. Here's everything you need to know.

Q Do I need a new Windows 10 licence after upgrading?

A You don't need or, indeed, get a new Windows 10 licence key when you upgrade, as we previously thought. After upgrading your Windows 7 or 8 to Windows 10, if you use a tool to retrieve your licence key from the Registry, you'll discover that all Windows 10 users share the same key. This licence is actually a generic key, which lets the installation continue without having to enter a real product key, but doesn't actually let your computer activate with Microsoft.

Instead, Microsoft has altered the way in which Windows works, and it no longer requires a licence key for upgraders. The first time that you upgrade your computer, it registers with Microsoft, sending its existing

Windows 7/8 licence key along with a digital fingerprint of its hardware. Next time when you perform a clean install, your computer sends the same digital fingerprint to Microsoft, which recognises the computer and that it has been authenticated before, activating it automatically.

Q Do I need a Microsoft account to register Windows?

A No you don't. The activate process is based on your computer's hardware and is not stored in your Microsoft account. This means, if you prefer, that you can create standard local accounts on your computer.

Q I bought Windows 7/8 retail; can I transfer it to a new computer?

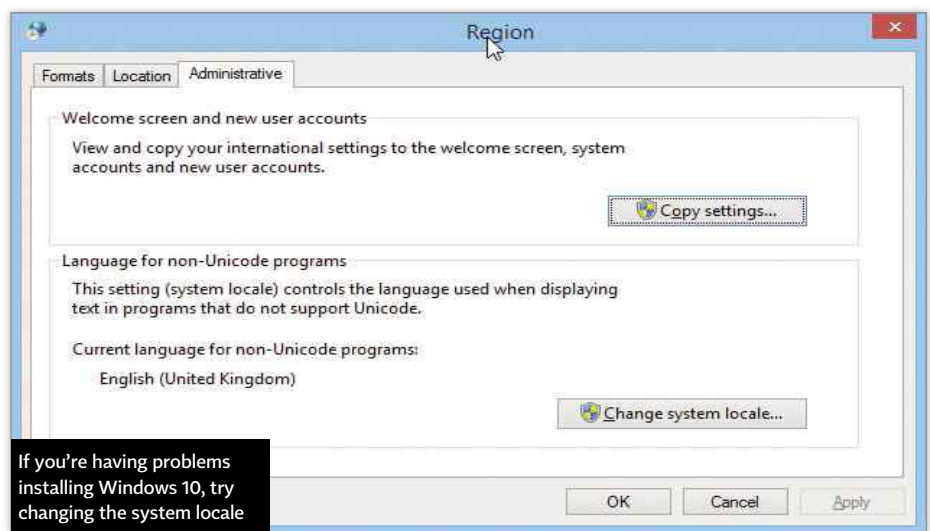
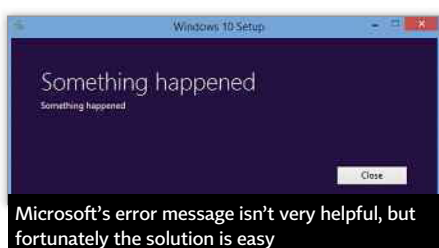
A The retail versions of Windows let you move the installation to a new computer, re-activating the OS on that PC. When you upgrade Windows 7 or Windows 8 retail to Windows 10, you retain the ability to move the licence to a new computer, but there are two main restrictions. To install Windows 10 on another computer, you first have to install your existing Windows 7 or Windows 8, and then upgrade it; you can then install Windows 10 from scratch on that PC. Second, after the year-long free upgrade period is up, you can no longer move your copy of Windows 10 to a new computer.

"After the first year, you would not be able to move the installation to a different device as the upgrade is specific to your device, not your licence or Windows account," Microsoft told us in a statement. "After that first year, for devices not upgraded you would have to purchase a copy of Windows 10 through the Microsoft Store or Microsoft retail partners."

You'll still be able to install your copy of Windows 7 or Windows 8 on the new computer, but the upgrade will no longer work. In other words, if you're looking to build a new PC for Windows 10 and want to use your existing operating system, you've got until 29th July 2016 to make the change or you'll have to buy a new copy of Windows.

Q What about OEM editions? Can I install Windows 10 after a year?

A OEM versions of Windows are tied to the computer they came with and can't be transferred to a different computer. Provided you've upgraded your existing OS to Windows 10 before 29 July 2016, you can clean-install the new OS as many times as you like on your existing computer, even after the upgrade offer has expired next year.



INSTALLATION BUGS FIXED

Although Windows 10 installs easily on most computers, there have been a couple of common bugs that a few people have run into. Here's how to fix the most common two.

'SOMETHING HAPPENED'

Microsoft has thrown out some useless error messages before, but the 'Something happened, Something happened' one has to be one of the worst ever, giving no clue as to what the issue is. Fortunately, the issue can be fixed in one of two ways.

The first option is to change your computer's Region settings and tell it you're in the US. To do this, open up the Control Panel from your computer's Start menu and select Clock, Language and Region, Region. Click the Administrative tab, click 'Change system locale' and use the drop-down menu and choose English (United States). Click OK and then OK again to apply the settings.

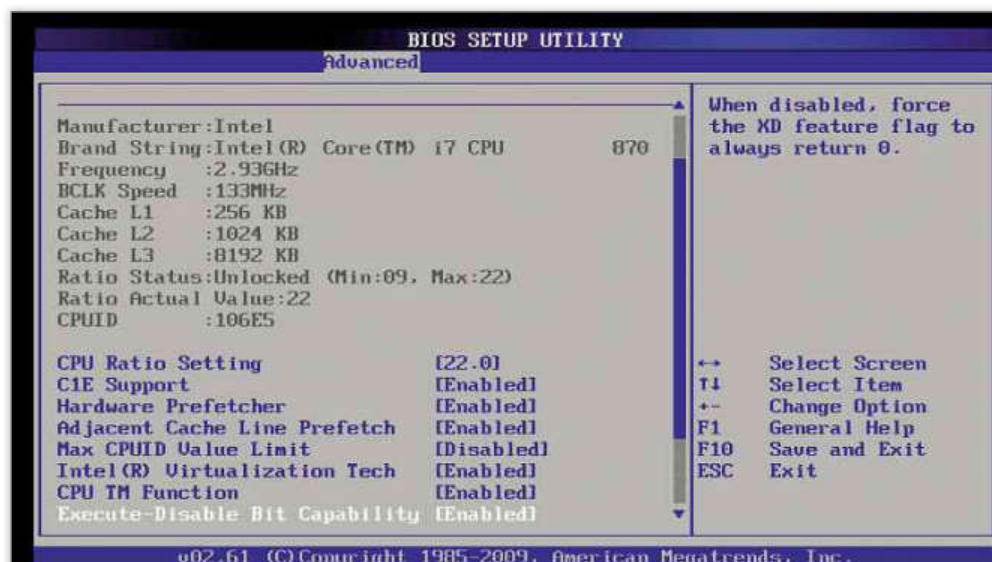
The second option is that you're trying to install Windows from a USB flash drive or DVD, but you created the installation media without the proper permissions. To change that, download the Windows 10 Media Creation Tool from tinyurl.com/win10mctool. Right-click it and select Run as Administrator. Follow the wizard through as before and

re-create the installation media. You should now be able to install Windows 10.

PROCESSOR NOT SUPPORTED

If you see the 'Processor not supported' message, it's because your CPU needs to support Execute Disable Bit. This feature is designed to stop malicious code from running on your computer by marking some bits of system memory as non-executable; it means if a virus infects this part of RAM, your system will refuse to run it. Practically any processor capable of running Windows 7 or Windows 8 has this feature, so the problem is likely to be that it's been disabled in your PC's BIOS.

To re-enable it, you need to restart your computer and go into the BIOS (Delete, F2 and F10 are common keys to enter it, but check your computer's manual for full instructions). Every BIOS is different, so the exact instructions will differ from computer to computer. Look for the section for your processor, such as CPU Configuration, which is likely to be in the Advanced section of the BIOS. Make sure that the Execute-Disable Bit is turned on, which may also be called XD or NX. Finally, make sure you've turned on the virtualisation option. Save your settings, reboot your computer and you should now be able to install Windows 10.



You need to enable Execute Disable Bit in the BIOS if you're getting a warning that your processor is not supported

Slow boot times



Although Windows 10 is generally quicker than previous versions, there is one area in which it can suffer: boot times. Here's how to speed it up

MANY PEOPLE WHO upgraded from Windows 8 to Windows 10 have suffered from massively lengthened boot times. The symptoms for this particularly curious bug include a black screen after seeing the Windows loading animation and your PC manufacturer's logo, and the ability to move your cursor around the black screen, but nothing else. For some, this process can take in excess of a minute.

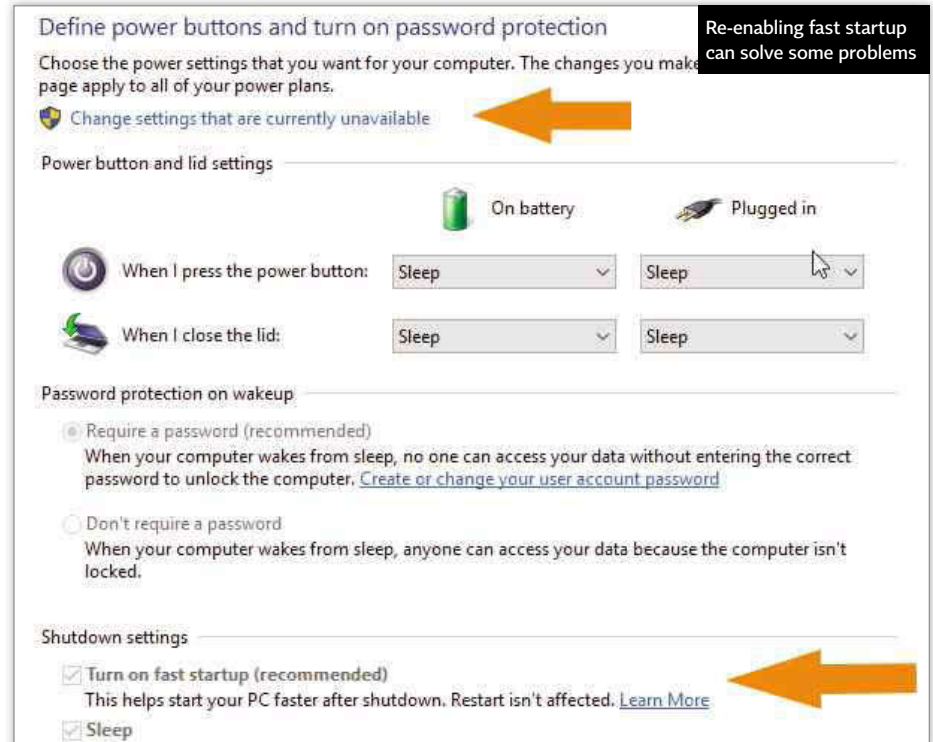
In our testing, we found two laptops that suffered from this problem: a Dell Inspiron 17 from 2013 and an Acer Aspire V5, also from 2013. The Acer added more than a minute to its initial boot time, while the Dell laptop's boot time shot up by 25 seconds, time that was mostly spent staring at a black screen.

There are various fixes we've seen working on our own laptops, and we'll start with the simplest first and escalate to more involved methods. Our thanks to the Microsoft Community users at answers.microsoft.com.

FAST STARTUP

We were largely able to fix the sluggish boot speeds of our Acer Aspire V5 by disabling Windows 10's fast start-up feature. To do this, open the Start menu, type 'power options' and select Power Options when it appears. When the window opens, select 'Choose what the power button does' from the list on the left of the window.

If you see a small blue and yellow shield icon and the text 'Change settings that are currently unavailable', click the text. You may need to enter your password or your PC administrator's password to do this. Now scroll down to the Shut-down settings list. Untick 'Turn on fast startup' and click Save changes. When you next switch on your PC



you should immediately see a significant cut in boot times. With our Acer laptop, the boot time dropped by 80 seconds. Most interestingly, switching fast startup back on made no difference; it would appear that the simple action of turning fast startup off and on again is enough to get Windows 10 out of its slow booting state, in this case at least.

GRAPHICS DRIVERS

The Dell Inspiron 17 proved to be much more troublesome, and while the methods below

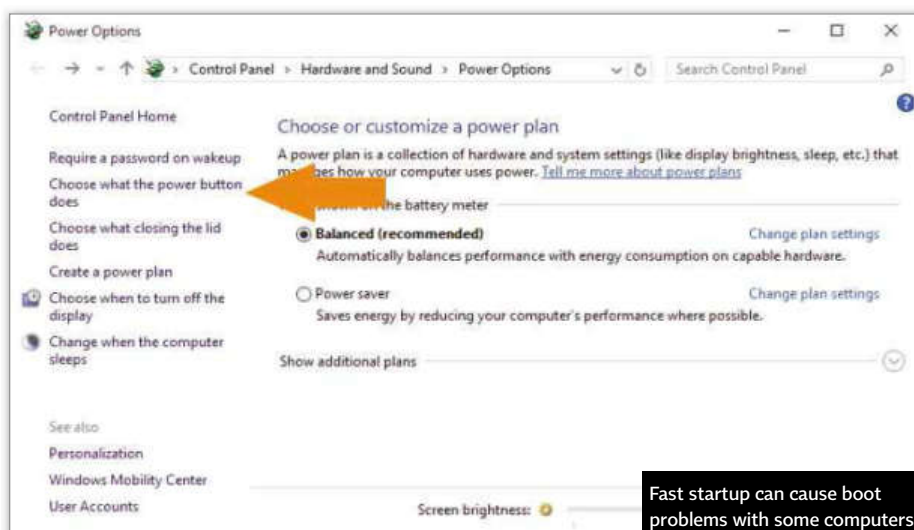
have apparently worked for many people online, it didn't fix our issue.

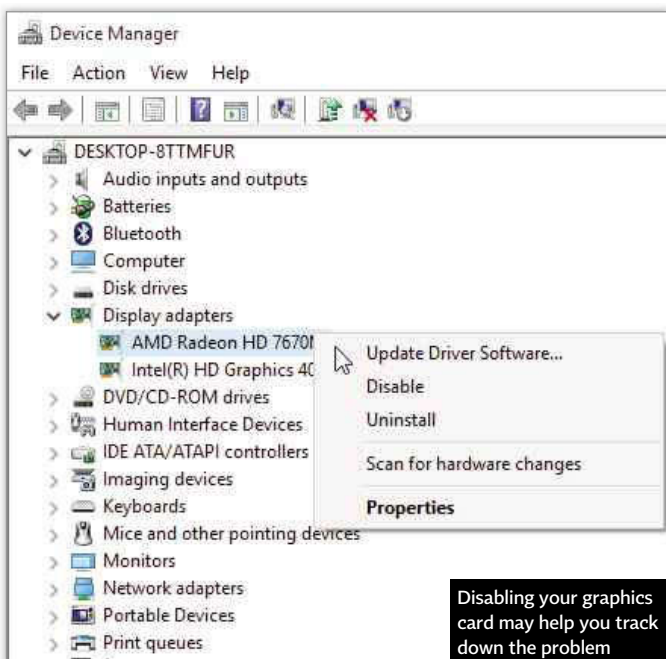
Some have suggested that the black screen before booting is a graphics driver problem that is particularly bad for those laptops that switch between Intel HD Graphics and a dedicated card from Nvidia or AMD. An easy way to verify this is to disable your AMD or Nvidia graphics driver and restart your computer. To do this, right-click the Start menu icon and click Device Manager.

Click Display Adapters and identify your graphics card. It will be labelled Nvidia, AMD Radeon or ATI Radeon. Right-click the graphics card and click 'disable'. This may cause your screen to go blank for a moment. Shut down your PC (not restart) and turn it on again to see if this has fixed the problem.

If you only have Intel HD Graphics, you do not need to do this. If your graphics card is causing the problem, re-enable it using the steps above and then download the latest version of your card's drivers from the manufacturers' websites (amd.com/drivers or nvidia.com/drivers). If you're not sure which driver to download, just select the option that automatically finds which card you're using. Once these drivers are downloaded and installed, shut down and restart your PC to see if the problem has been solved.

If your PC is still slow to boot, it's worth checking if toggling fast startup off and on is more effective with your new drivers.





AMD POWER SAVER

If you're still experiencing problems and you have an AMD graphics card, there is one more step you can try. Go to the Start menu and type 'regedit'. Open the Registry editor and click the Edit button at the top of the screen, then click Find. Type 'EnableULPS' and click 'Find Next'. EnableULPS will be highlighted in the list of Registry options.

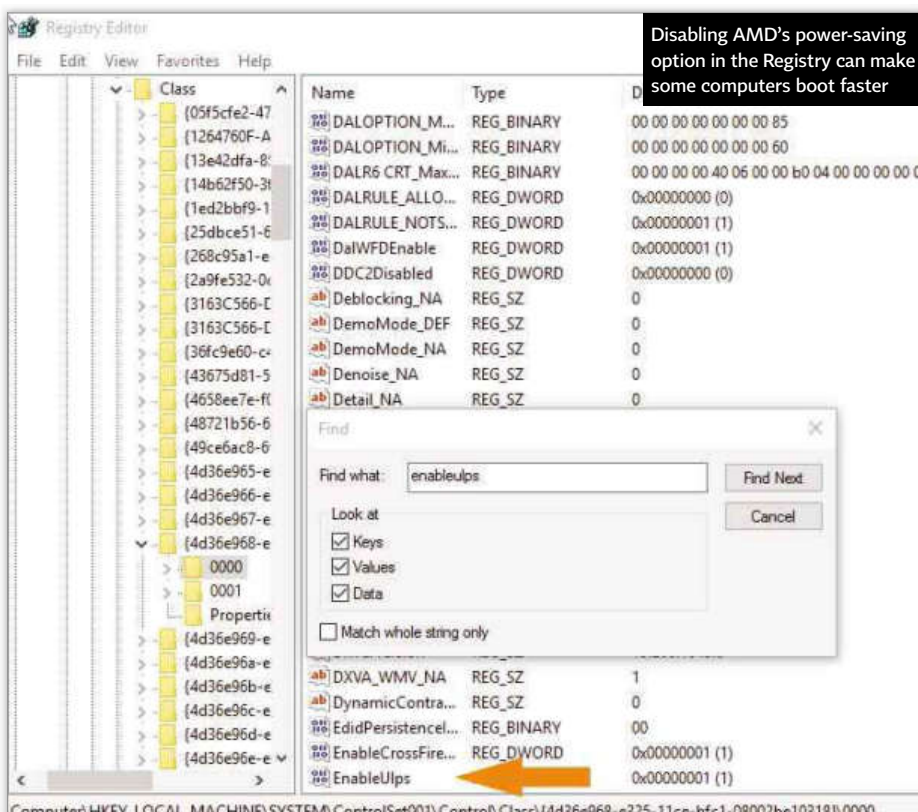
Double-click it, and change the value from 1 to 0. This will disable a power-saving feature that switches off your dedicated graphics card when it's not needed. However, disabling this option will mean that your laptop consumes more battery power, so only do this if your laptop spends most of its time plugged into the mains.

If you're going to do a complete Windows 10 reset, make sure your files are backed up as they will be lost in the reset process. If you choose to reset Windows 10, you'll lose the option of going back to Windows 7 or 8 forever, so you may end up being stuck with Windows 10 unless you have a Windows 7 or 8 system image or restore partition.

For us, resetting Windows 10 completely was the only way to solve our boot issues on our Dell laptop. The boot issues still remain when the PC is restarted, but as long as fast startup is enabled, we no longer see the black screen. In addition, you can skip all of this entirely by choosing to put your computer to sleep instead of shutting it down every time you've finished using it.

IF ALL ELSE FAILS

If none of the above works, you can either downgrade back to Windows 7 or 8.1 (if you installed Windows 10 less than a month ago), or restore Windows 10 to its default settings, removing all your files and programs. To do this, search for 'reset' in the Start menu and click Reset this PC, then Get Started if you want to reset Windows 10 or the other Get started option if you want to downgrade. You can also do a clean install of Windows 10.



Measure boot times with BootRacer

Even if you don't have any problems with boot speeds, BootRacer is a handy tool to track and improve the time it takes from powering on your PC to arriving at the desktop. First, download and install the software from tinyurl.com/bootracerdownload. The download will begin automatically.

01 Once the program is installed and open, click 'Boot Time Test' to restart your PC and start recording boot times.

02 When Windows has almost finished starting up and is ready for use, a countdown clock will appear. This lets you know when all your startup programs have finished loading. Once it's



done, you can click the 'Good To Go' button to see how your system performed and where it was losing time.

Note that in the graph, the time you take to type in your password is not counted in the end result. In the case of the Windows 10 boot bug, some of the lost time can be found in the logon screen, so it's worth looking at this data to see if your problem is improving or getting worse.

03 After you've made changes, be it uninstalling programs or disabling startup programs, you can restart and find out whether things have improved. You can also see how it now compares to previous boot times by clicking on the History button.



Privacy problems



Some of Windows 10's new features have people worrying about an invasion of privacy. Here are the main culprits, the real threats and how to deal with them

WINDOWS 10 HAS brought with it a huge list of improvements and added conveniences, but some users have become concerned over how connected the operating system is to the internet and are beginning to wonder how Microsoft is using their data.

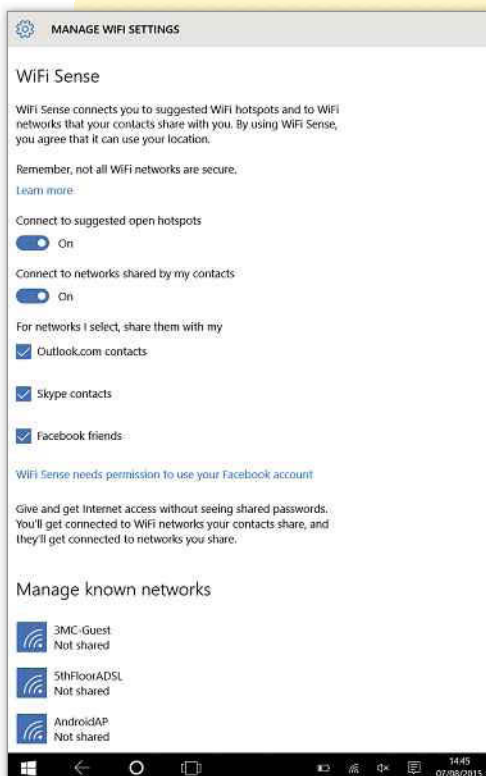
In this guide, we'll look at the settings causing concern, and what you can do to fix them. We'll also evaluate whether they're worth making a fuss over in the first place. You can find most of these settings by going to Settings and clicking Privacy.

1 Wi-Fi Sense

This setting initially caused real concern, but just a little research proves that this was overblown. Wi-Fi Sense allows you to share Wi-Fi networks with your contacts (Facebook, Skype and Outlook), allowing them to connect without a password. You have to explicitly enable this for each Wi-Fi network you connect to.

Additionally, only those with the password can give their contacts access; so if only you know the password, only you can choose who gets to connect to your network, and your friends can't share it with their friends. It's more secure than giving your friends your Wi-Fi password: because they never know it, they can't share it with anyone.

You can change these settings by searching for Manage Wi-Fi Settings on the Start menu.



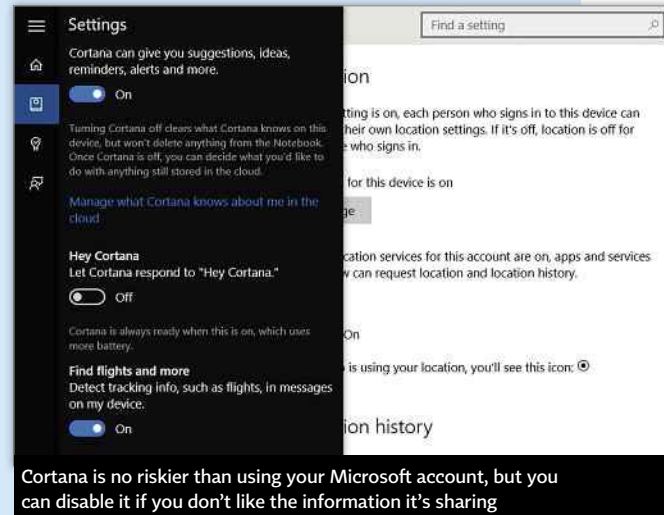
Wi-Fi Sense sounds scary, but it's not really a risk to your wireless network's security

2 Cortana

Cortana is Windows 10's personal assistant software. In order to be useful, it needs access to some of your personal information. It can access all sorts of data, including your microphone, your location, your contacts and your calendar. If you're not comfortable with this, which is a natural reaction to have when a new service wants to have access to everything in your digital life, you can turn it off easily.

Search for Cortana in the Start menu and go to Cortana Settings. Toggle the first option to the off position, and Cortana won't have access to anything.

You can also turn off individual features, such as "Find flights and more". This function accesses your messages to find bookings for things you need to remember, such as a restaurant or a flight. This is similar to how Google Now works, and is useful if you want up-to-date information about a flight or other booking. Remember that if you use Outlook for your calendar, contacts and messages, then Microsoft already has your data as it is the company providing the service; allowing Cortana access to this data isn't a massive leap from what you're already doing.



Cortana is no riskier than using your Microsoft account, but you can disable it if you don't like the information it's sharing

3 Advertising ID

If you don't like personalised ads chasing you around the internet, you should absolutely deactivate this setting. However, you'll still see ads, so if you'd rather see stuff that actually interests you, you can keep it on. Either way, your general usage experience will not be affected.

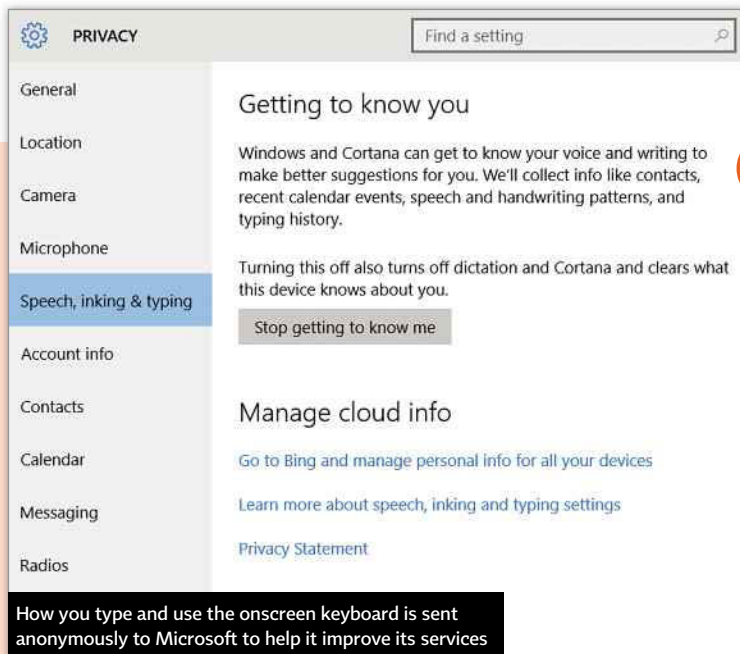
You can change most of the common privacy features from one place in the Settings app

4 SmartScreen Filter

This setting tracks the URLs in apps you download from the Windows Store. Since you can't trust every URL that an app might ask you to click, you should keep this setting on.

5 Language List

This benign setting allows apps and websites to alter their content based on the language your device is running. This might be helpful when accessing a website that's not written in English.



6 Getting to Know You

Typing (and handwriting) information is held on your device to improve the accuracy of the onscreen keyboard and handwriting recognition. This setting also sends information over the internet to Microsoft to help improve this further. According to Microsoft, this information is used to help the predictions engine as a whole, not your specific account. The company says data is put through 'rigorous' anonymisation processes so no personally identifying information is captured.

If you navigate to the Privacy, Speech, Inking and Typing menu, you'll be able to stop your device from learning about your habits by selecting 'Stop getting to know me'. However, this will affect how well Cortana can serve you.

Some of this information may also be stored online; click the 'Go to Bing and manage personal info for all your devices' button to get an overview of your Microsoft account and its privacy settings.

7 Account Info

Some apps will want to use your Microsoft account information, such as your name and profile picture. The setting also says apps might need 'other account info', which is rather vague. We've asked Microsoft exactly what this means and will update you if we get a response. You can adjust individual app settings and whether they're allowed to use this information from this menu.

8 Camera and Microphone

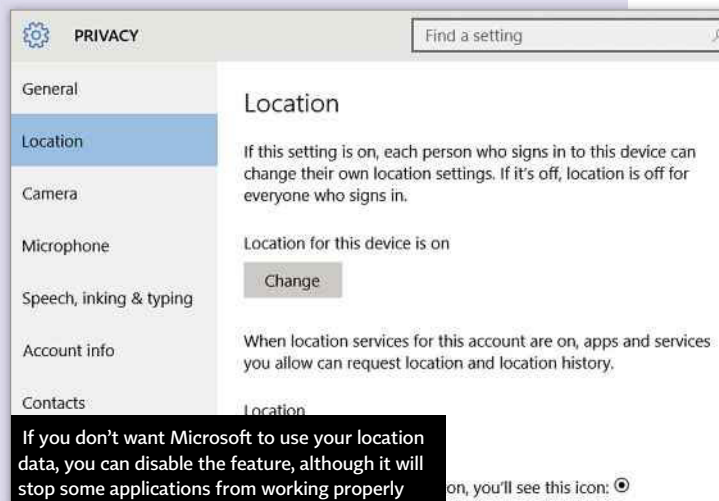
These settings are straightforward. You can allow or disallow individual apps from using your device's built-in camera or webcam. You can disable it entirely, too, to make sure no apps can use it. If you don't trust all the apps you have installed, it's worth re-evaluating the apps you've download and finding out why they want to use your camera and microphone.

9 Location and location history

If you're using a desktop PC, you can turn off any Location settings without fear of missing out. If you're using a laptop or tablet, Location settings will affect some of your apps, such as weather and mapping applications. Additionally, turning off location settings will disable Cortana.

You don't have to turn off Location if you don't want to; each time a new app wants to use your location, Windows 10 will notify you and you can either allow or deny it access to your location. Depending on the app, this may stop it from functioning entirely. You can allow or deny individual apps access in the Privacy, Location menu; scroll down to the bottom and you'll see a list of apps and whether they can access your location details.

Bear in mind that legacy applications (those not downloaded from the Windows Store) may still be able to access your location through other means, such as Wi-Fi hotspots or mobile data information. Also bear in mind that your location history will be stored on your device in order to allow apps to give you more localised content. You can clear this setting at any time from the Privacy, Location menu. If you switch off Location, your location history won't be stored.



10 Contacts and Messaging

Some users were concerned about the use of contact and messaging data. In reality, this is similar to how contacts are used in smartphone apps; if an app wants access to your Microsoft contacts and messages, it will have to ask first. If it doesn't have a good reason to access your contacts or messages (it's not a messaging app, for example), then you should deny it. Bear in mind that your Microsoft contacts are already stored online, so stopping Windows 10 from accessing them is unlikely to improve your privacy situation.

Privacy and Windows 10: our verdict

We like to take a healthy dose of cynicism wherever we go, and we approached Windows 10's privacy settings with just that. You should always be concerned about how your data is used and, for the most part, Microsoft has done a fairly good job of explaining how it uses data and makes it exceptionally easy to turn off any settings you don't want.

It is a little concerning that the world's most popular OS has taken such huge steps towards keeping track of our lives by default. When you first install Windows 10, if you choose 'Express Settings', all the features mentioned here will be switched on by default. It pays to read the small print carefully before you install Windows 10.

It's also worth bearing in mind that with such a huge user base, Microsoft will have a massive amount of data at its disposal, which could make it very popular with advertisers. This is partly why Google has been so successful with its Android operating system: lots of user data equals lots of advertising cash. Still, Microsoft's help information, which is available in each of the settings menus listed above, is easy to understand and does a decent job of explaining things.

Application settings



Don't want Edge as your default browser? Want a different app to open certain files? Our tutorial will show you how

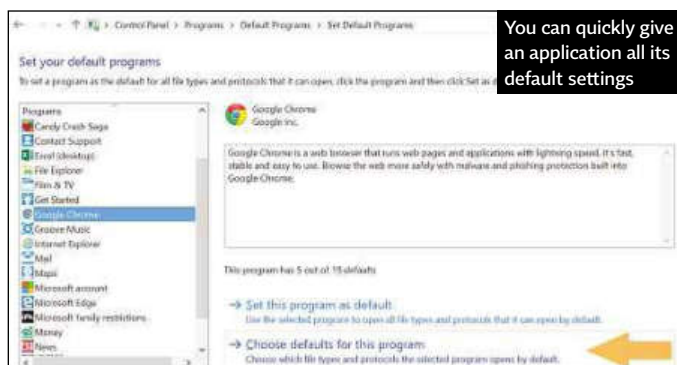
IF YOU'VE UPGRADED to Windows 10, you might have found that Microsoft's Edge browser has become your default browser. While our browser performance benchmarks confirm that Edge is a fast browser, you might not be prepared to drop your current favourite browser just yet. Annoyingly, in Windows 10, Microsoft has made it a little bit trickier to change your default browser. We'll show you how to make the change quickly, so you can use your browser of choice, as well as how to change other default applications.

SET DEFAULT PROGRAMS

First, close all web browser tabs and windows you currently have open. We found that changing these settings with a browser open would cause it to crash, which could mean you lose data. Open the Start menu, type 'default programs', and select Default Programs. Then select 'Set your default programs', which is the item at the top of the list.



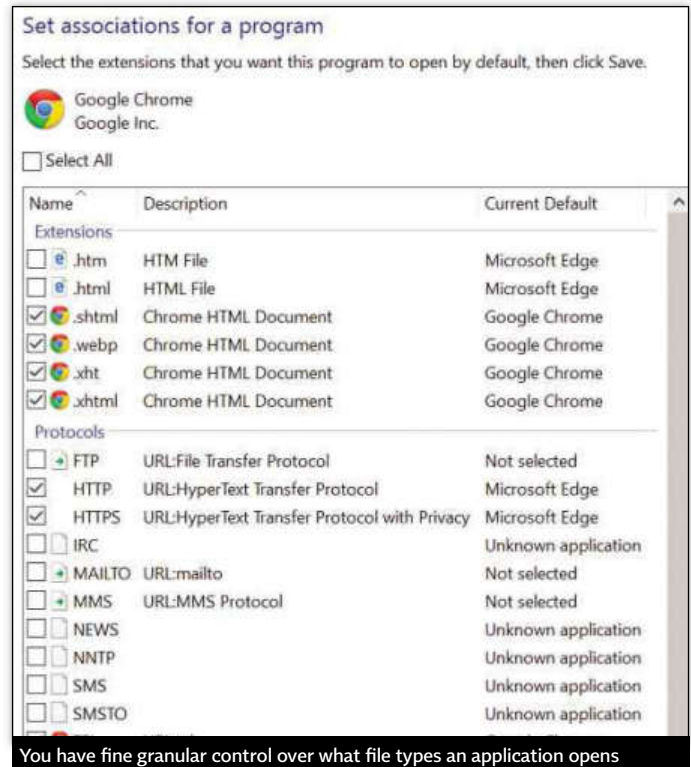
Windows has to build a list of all the applications that are installed on your computer, so you'll have to wait a few seconds while it populates the list. Once it's done so, you'll see a list of installed applications in the left-hand column. Scroll through this list until you find the browser you want to use and click to select it. If you want your browser to be the default application for every file type and link that it can deal with, click Set this program as default.



GRANULAR CONTROL

If you want to open some things in this browser but have other programs open other types of files or pages, select 'Choose defaults for this program'. Here you can select what your browser will open by default. You'll need to tick several boxes to ensure every web page opens in your browser of choice. Under the Extensions heading, ensure all the file types under this heading are ticked. The most important ones are HTML and HTM, but if you want all web pages to open in your favourite browser, you should tick all of the options.

Under Protocols, ensure HTTP and HTTPS are ticked, as this will cover every link you get from chat messages and emails. If you have no specific requirements and want everything to open in your favourite browser, just tick the 'Select all' box.



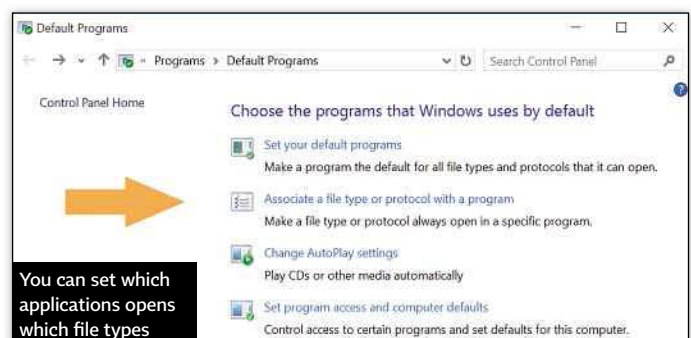
Microsoft Edge may also be set as your default PDF reader. This is handy if you have no other software that can read PDFs, but if you do, you'll probably want to switch to that. Find your PDF reader or word processing software in the list of programs in the default programs list, and make sure .PDF is ticked under the Extensions header.

OTHER PROGRAMS

The same changes can be applied to any program on your PC. If you'd prefer to open JPG files in Paint.NET instead of Windows Photo Viewer, for example, you can include JPG files in Paint.NET's default files list.

You can also do this in reverse: instead of setting defaults by program, you can set them by file type. This takes a lot longer but it's the best way of being able to customise individual file types to a multitude of programs, and will probably be useful to those who work with different video and image formats and use different programs for each. To do this, select associate a file type or protocol with a program.

Double-click the file format or protocol you wish to change, and you'll be presented with a list of all the programs you can open it with. Only programs you currently have installed will be on this list.



Downgrading to Windows 7 or 8



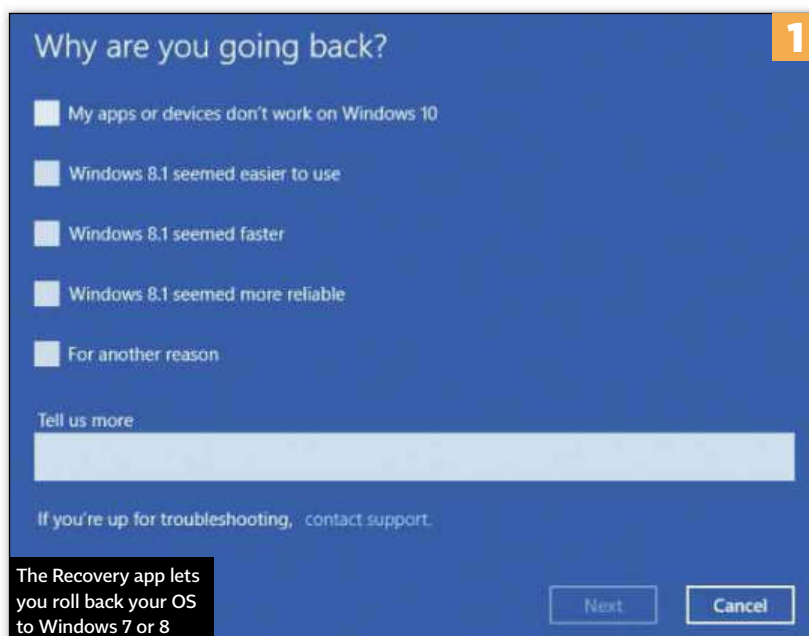
Finally, if you've found that Windows 10 isn't really the OS for you, you can simply restore your computer back to its original state. Here's how

WE THINK THAT Windows 10 is great and that everyone should upgrade to it where they can. However, if you've upgraded and are now finding that the OS isn't right for you – perhaps you have some unsupported hardware, for example – you may want to go

back to your original OS. Fortunately, this is easy to do, as the upgrade process saves details of your old version of Windows. Provided you haven't run a disk cleanup on your system, deleting your original files, you can just roll back your computer to its

previous operating system. A final restriction is that you have just one month from upgrading to complete the operation.

Make sure you've backed up important files before you follow these instructions, just in case something goes wrong.



01 OPEN RECOVERY

Click on the Start menu, type 'recovery' into the search box and click Recovery Options. This will launch the Recovery app, which lets you refresh or restore your PC. If a previous operating system is available, the second option will start 'Go back to Windows xx'. Click Get Started.

Don't have a restore option?

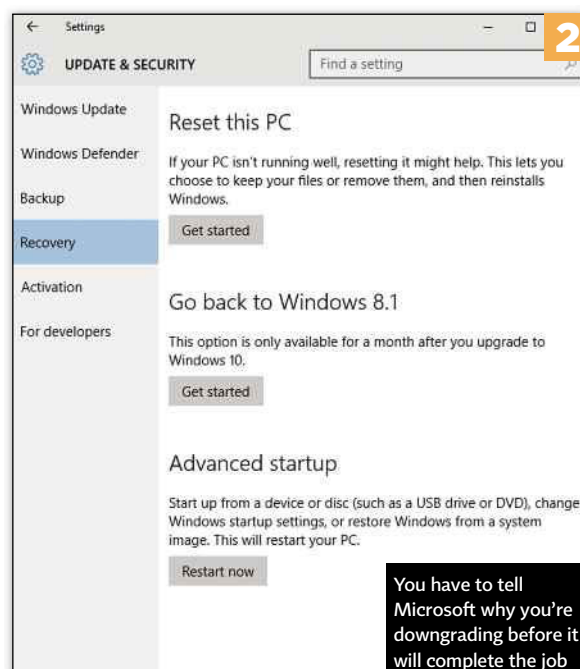
If you've left it too long to restore your computer or you deleted your recovery files, you'll no longer have a restore option for your previous operating system. At this point, you have two potential options. First, if your computer's manufacturer created a restore partition, you should be able to reboot your computer and flash your computer back to its original state. Please note that this will wipe your files and applications, so you must make sure that you back up everything first. To find out how to restore your computer this way, you'll need to check your computer's manual for help or contact its manufacturer directly.

Second, if you have the original Windows installation disc, you can just perform a clean install on your computer. Again, this will wipe everything on your computer, so make sure you've backed up anything important.

02 SELECT A REASON

You'll get a dialog box asking you why you want to downgrade, and you must select a reason from the list before you can click Next. After clicking Next, you'll see a warning message telling you that you can't use your computer until the process has completed and that you must leave it turned on.

Click Next to agree and Next again on the final warning page, which tells you that you'll need to know the password to log into your old version of Windows. Finally, click the Go back to Windows XX button and your computer will be restored to its previous version.



If you have the original Windows installation disc, you can just perform a clean install on your computer

03 Reboot and choose what to do

Your computer will reboot and go back to your previous version of Windows, complete with your files, settings and applications. You can now continue using your computer as before, but you can upgrade to Windows 10 again at any point, or choose to clean-install Windows 10 on your computer. **CS**

THE SHARING ECONOMY

Online platforms such as Airbnb and Uber are transforming the way we work, consume and interact. But is the sharing economy really a grassroots revolution or just another boost for big corporations? **Ben Pitt** investigates

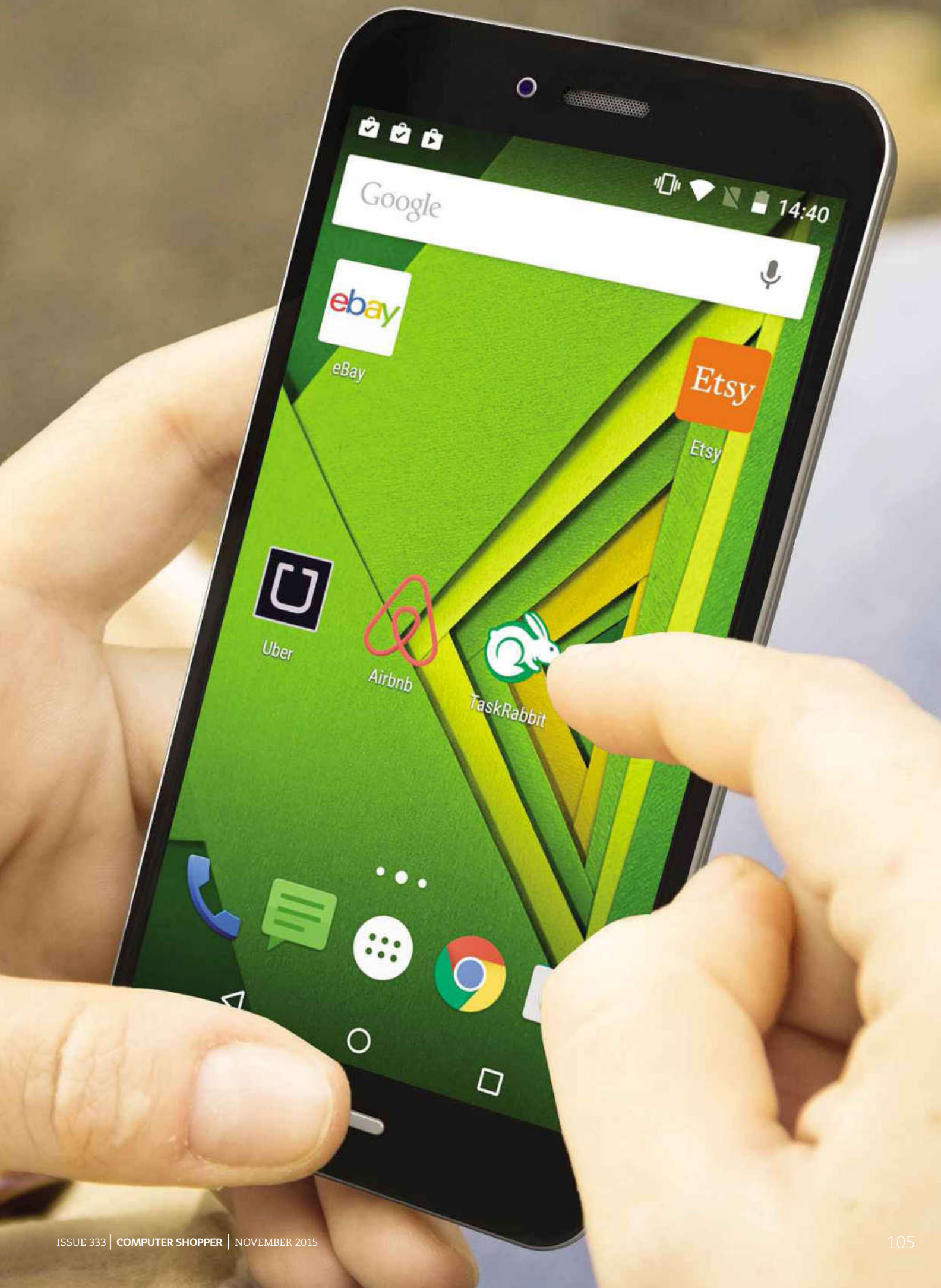
Back in January 2012 we published a feature about peer-to-peer business ('Cut out the middleman', *Shopper* 287). It was a brave new world that no longer relied on big corporations to sell us products and services. Instead, individuals would trade directly, and the middleman was reduced to an automated web-based system that matched people with compatible needs.

This new way of interacting isn't limited to buying and selling. These peer-to-peer transactions are ideally suited to hiring, lending and swapping goods, and for sharing skills and information. It challenged the idea that a product has an intrinsic value; instead, the value was in the end result. Why buy, store and maintain a step ladder or drill if you only use them once a year? The value is in the hole halfway up the wall. By itself, ownership is a burden, not a benefit. The main advantage of ownership is that goods are readily available when you need them. If technology is able to deliver near-instant

access without the burden of ownership, you can have the best of both worlds.

Even a car might only be used for a couple of hours a week. The rest of the time it sits idle. No one feels the need to own their own train, so why should a car be different? Get over the idea that it's your car and the cost of getting from A to B plummets.

This sharing economy – where people unlock the idle capacity of their possessions – wasn't a new idea in 2012. People have been borrowing ladders from neighbours and renting out rooms to lodgers for centuries. The difference was that technology was making these transactions easier. In 2012 Airbnb was already well established, and so too were other related companies such as eBay, Wikipedia and ZipCar. They were being joined by a swathe of new businesses built on peer-to-peer transactions and powered by web browsers and smartphones. It felt like the start of something big, an idea that could transform everything from product design and manufacture to people's sense of community. ➔



CAR SHARE

FAST FORWARD TO 2015

Almost four years later, these concepts have passed a tipping point in public awareness. "Sharing economy" now appears in the Oxford English Dictionary. In March 2015 a new trade body called Sharing Economy UK was formed to promote the sector. A few days later the term cropped up in George Osborne's Budget speech.

The full Budget report detailed a wide range of policies to back this up. JobCentre staff would be instructed to point jobseekers towards sharing economy opportunities. Guidance for local authorities would be updated so that existing parking spaces on non-residential properties could be rented out (it's already possible for residential properties). The standard wording for tenancy agreements would be amended so it no longer prohibited tenants from sub-letting rooms. The Space for Growth scheme for renting government workspaces out to small businesses would be expanded. Government employees would be encouraged to use more sharing economy solutions for accommodation and transport. Sharing economy hubs would be piloted in the Leeds and Manchester areas "to trial local sharing initiatives in the areas of shared transport, shared public space, and health and social care".

Peer-to-peer transactions rely on trust between users, and in some cases people's trustworthiness needs to be verified. To facilitate this, criminal record checks would be fully digitised and integrated into sharing economy platforms via an application programming interface (API).

These Budget announcements and the new trade body came in response to a government-commissioned independent review entitled *Unlocking the Sharing Economy*, published in November 2014. Its remit was to make recommendations on how the UK could become a global leader in this sector. While its author was independent of the government, it wasn't exactly an impartial voice. It was penned by Debbie Wosskow, CEO of www.lovehomeswap.com, which lets people stay in each other's homes for free – as long as they pay a monthly membership fee to Wosskow's company.

CLASS OF 2012

The sharing economy is clearly on the UK government's radar, but how is it shaping up for the nation's entrepreneurs? We checked in on the various companies that we profiled back in January 2012.

Gaboom was a second-hand game-swapping service run by a 21-year-old entrepreneur called Jessica Ratcliffe. It was a slick



operation that was getting a good deal of press attention. The website is now closed, and Ratcliffe has emigrated to San Francisco, where she's product manager for Sleepio, a company that uses web-based services to help people get a better night's sleep.

Ecomodo had a much broader aspiration, to help people "lend and borrow each other's everyday objects, skills and spaces with confidence". Its users could join lending circles based on location, interests or any other criteria – perhaps colleagues in a large company – and share possessions, time and skills, either for cash or for free.

The business seemed well-conceived and realised, with insurance and dispute-resolution systems in place. However, such an ambitious project would always face a challenge reaching critical mass. It was an eBay for sharing and renting rather than selling, but that meant it required people to be local to one another. We enjoyed browsing the site to see the wide array of goods being offered in our area, but it wasn't often that the specific thing we needed was being offered locally. Ecomodo ceased trading in March 2015.

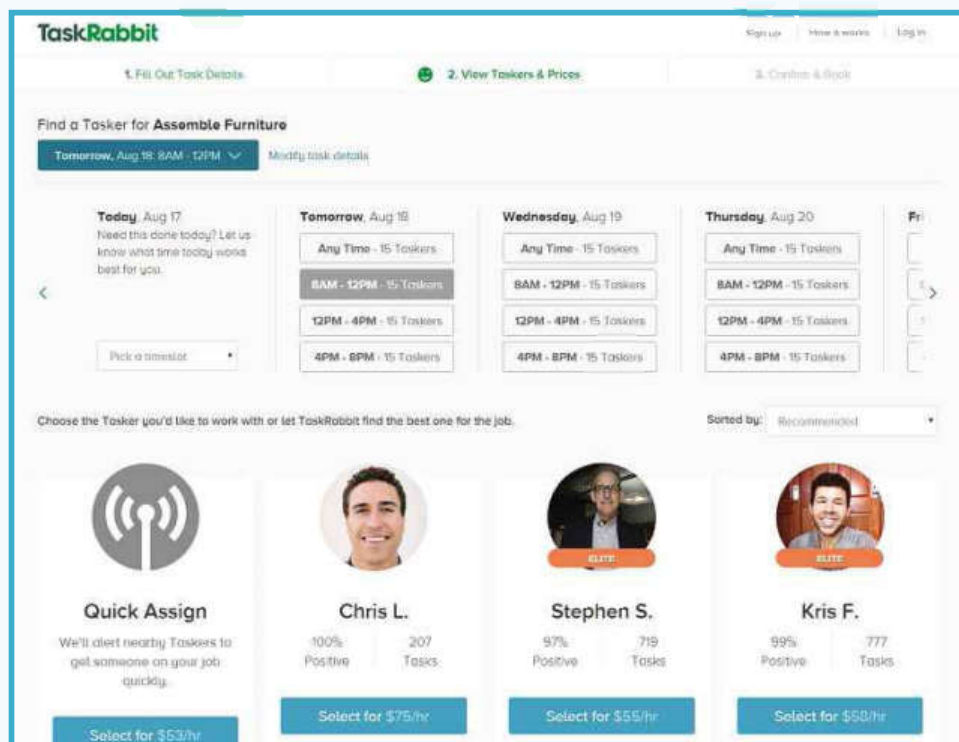
WhipCar was a peer-to-peer marketplace for car hire. Anyone who owned a car less than eight years old could advertise it on an hourly, daily or weekly basis, set their price and accept or reject requests at their convenience. A reputation system encouraged responsible lending and borrowing, and fully comprehensive insurance was provided, with the company taking a 15% commission. It had 3,000 registered cars across the UK, but in March 2013 it announced it was closing and cancelled all bookings from that day onwards.

Rival service easyCar Car Club is still going strong, though. It's part of Stelios's easyGroup and backed by

easyCar Car Club is a marketplace for people to hire cars from each other

The screenshot shows the easyCar Car Club website interface. At the top, there's a search bar and navigation links. Below, a map shows the search area around London. Several car listings are displayed, each with a photo of the car, the owner's name, car details, and pricing options.

Car Model	Owner	Price (per hour)	Price (per day)	Price (per week)
Qasim's Volkswagen Polo	Qasim	£11.50	£33.28	£144.53
Zaheer's Nissan Micra	Zaheer	£11.50	£33.28	£144.53
Huma's Honda Jazz	Huma	£16.50	£43.50	£271.38
Om's Ford Fiesta	Om	£11.50	£35.18	£144.53



background checks and must submit a video interview and wear a branded uniform. They're assigned jobs rather than browsing and bidding for them, and must respond within 30 minutes. Taskers define what hours, locations and kinds of tasks they're available for, and what their hourly rate is. TaskRabbit's guidelines say it expects Taskers to accept tasks that fall into the boundaries they have set, with a few exceptions. "Some legitimate reasons for forfeiting a task include: believing you cannot deliver a high-quality experience for the Client, not having the proper tools for the task, or feeling unsafe about a task. Scheduling conflicts are not considered a legitimate reason for forfeiting a task given the schedule management tools we provided."

The reason for this change in business model, according to a TaskRabbit blog post in June 2014, was to alleviate the time delay and

Brent Hoberman, the man behind Lastminute.com and Made.com. Another continuing success story is ZipCar, which has its own fleet of cars dotted around the streets in seven UK cities. In March 2013 ZipCar was bought by Avis Budget Group for US\$500m. Then there's Uber, which operates as an online minicab controller to let anyone with a smartphone hail a cab. In July 2015 this privately owned San Francisco-based company was valued at \$50bn.

YourJobDone was a modern concierge service, connecting people who have small jobs that need doing with people willing to do them. It connected people automatically based on location, skill, reputation data (from previous jobs) and the amount of money on offer. When we talked to its co-founder David Caldwell in 2011, he explained that the company wasn't currently taking any commission as it was pushing for adoption. However, the company struggled to secure additional investment and had folded by the time the article was printed.

There was nothing wrong with the concept, though, as demonstrated by the success of TaskRabbit. Launched in 2010, its headquarters are in San Francisco and it now operates in 19 cities, including London. It has raised \$40 million in funding and has 25,000 people on its books, ready to perform tasks.

It's interesting to note that the business model was overhauled in 2014, with those doing the tasks – known as Taskers – now operating more like employees rather than part of a peer-to-peer transaction. Taskers are subjected to

Book someone for jobs such as cleaning, house removals and plumbing with TaskRabbit

"pricing anxiety" of auctioning a job to the lowest bidder, and to ensure that clients could leave the site knowing they had secured a Tasker for a set price. The advantage for Taskers is not having to spend time browsing the site looking for work. If it leads to more happy clients, that should be good for the Taskers, too. However, we'd argue that – for better or worse – the spirit of the peer-to-peer transaction has been somewhat lost along the way.

Zopa was the longest-established company of the five we talked to, dating back to 2005. It's a peer-to-peer bank where lenders are matched directly with borrowers. This puts lenders' money at risk if borrowers default, but by spreading investments across multiple borrowers, this risk becomes reasonably predictable. The result is a better rate for both parties. Zopa takes a smaller cut than the traditional banks, and can afford to because it doesn't take on the risks.

Zopa is still going strong in 2015, with £992m of loans over 10 years including £280m in the last year. It has 51,000 active lenders and an average of just 0.6 per cent of bad debt over 10 years. It was used by the Department for Business Innovation & Skills to distribute funding to sole traders as part of its Business Finance Partnership scheme.

WHO'S SHARING WHAT?

The sharing economy carries lots of potential benefits. Peer-to-peer transactions mean both parties get a better deal by cutting any overheads of a middleman, most traditionally a retailer. The shift towards hiring or borrowing, rather than buying, means things are used more efficiently, which not only saves



ODD JOBS

Leading P2P Lending x

www.zopa.com/lending

Get a loan Lend your money

Lending How lending works Rates explained Risk management

A better way to grow your money

Get more from your money by lending it directly to sensible borrowers.

Try our 5.0% interest calculator

I want to lend £2000

plus £100 per month

at a projected rate of 5.0%

over 6 years

£10,928

projected value after 6 years. Made up of £9,100 capital and £1,828 interest.

- ✓ After defaults
- ✓ Before tax
- ✓ Assuming re-lending
- ✓ Lending in 4 & 5 year loans

Get started

Cutting out the banks in the middle gets everyone a better deal. We call this **peer-to-peer lending**, we invented it and we're here to make money simple and fair.

sharing economy platforms such as TaskRabbit and Uber are growing the fastest. Surely, the sharing economy should do more than create jobs at the bottom of the heap.

IS THIS REALLY SHARING?

But are these really sharing economy services in the strictest sense? How much do Uber, ZipCar and easyCar Car Club have in common, and what differentiates them from a conventional car hire or taxi service? Perhaps it's just that you can book them with an app.

In Wosskow's independent report she defines the sharing economy as "online platforms that help people share access to assets, resources, time and skills". It's difficult to know where to draw the line, though. Does Uber unlock the idling capacity of a car or is it just an app-powered taxi service? What's being shared when you use TaskRabbit to book someone to clean your bathroom?

Wosskow's report identifies three examples of different types of sharing economy company: peer-to-peer marketplaces where people can produce goods and sell directly to customers, such as arts-and-crafts marketplace Etsy; hire schemes such as City Car Club, where people share access to goods rather than own them; and time banks such as Economy of Hours, where people trade time and skills, hour for hour.

Rachel Botsman, author and lecturer for the movement she calls the collaborative economy, breaks it down into four distinct ideas. A collaborative economy is a marketplace of distributed networks rather than centralised institutions, such as Etsy or eBay. A sharing economy is where individuals unlock the idling capacity of their assets, such as easyCar Car Club. Collaborative consumption is the sharing, swapping, trading or renting of assets, driven by technology, such as ZipCar. Then there are on-demand services, where digital platforms match customer needs with providers, such as Uber.

Some businesses span multiple categories. Airbnb, for example, is a distributed network (collaborative economy) of individuals unlocking the idling capacity of their homes (sharing economy) by renting them to others (collaborative consumption). However, an Airbnb property that is only owned to be rented out stops become an idling resource and is more of an on-demand service – essentially a hotel that's booked through a website or an app.

And in terms of the sharing economy, renting out your home to others when you go away for the weekend may be making use of an unused resource from your point of view. However, if it leaves another home empty elsewhere then there's no net gain for society as a

money for all concerned but also reduces the strain on natural resources and lowers carbon emissions. Sharing goods, skills and time with neighbours also has a strong social benefit, getting people out from behind their screens and talking to each other.

Perhaps it's still early days, but so far we can't see much evidence of these benefits taking root. The vast majority of us still buy disposable consumer goods, save with high-street banks and own our cars. There's no general lending or hire scheme along the lines of Ecomodo that has reached critical mass. The nearest popular equivalent is eBay, which although simply a retailer, has helped us make huge strides forward in giving used goods a second home.

Despite this one success story, global consumption of natural resources continues to grow. Overshoot Day, the date when the Earth's population has used its yearly quota of natural resources, came earlier than ever in 2015, on 13th August.

If it's not in goods, then maybe the sharing economy is providing benefits in employment? The stats looks good, as according to a 2014 report from the Office for National Statistics, 15% of the UK workforce is self-employed; the highest on record. Of the 1.1 million jobs created since the economic downturn in 2008, almost three-quarters of them are people who've become self-employed.

However, the average income for self-employed people has fallen by 22% over the same period. London has seen the biggest growth in self-employment, up by 17.3% in that time. Perhaps it's no coincidence that London is where

Earn a better rate on your savings by lending – via Zopa – directly to other customers



FINANCIAL

HOUSE SHARE

whole, unless your guests are also renting out their home, of course. However, it could be argued that renting your high-demand flat in central London to someone who leaves their low-demand suburban house empty is at least helping balance demand and supply.

For what it's worth, we'd split the sector into a different set of distinct but overlapping concepts. There are peer-to-peer transactions such as eBay and Zopa. There's idling capacity, which exploits assets that would otherwise be unused, such as Airbnb in many cases. There's using without owning, such as ZipCar, which may or may not have an idling capacity element. And there's peer-to-peer labour, where automated digital platforms allow people to find work, such as TaskRabbit.

We asked Rachel Botsman whether this confusion over definitions posed a problem. "The sharing economy is going through a real brand crisis," she commented. "Many of the services the media is putting under this umbrella, the companies themselves would even say they are not in the business of sharing per se. Apps that in some way connect providers and customers directly to deliver goods on demand such as Washio or Deskbeers are often put under the term. Honestly, I don't think users care about the term and the term itself will become less of an issue as the behaviours and ideas become more and more mainstream."

Airbnb lets people rent out spare bedrooms for some extra cash, and for guests it might be a more interesting place to stay than a hotel

with millionaires, created not just by the successes of Apple, Facebook, Google and PayPal but also by the on-going boom in tech start-ups – of which sharing economy platforms are a big contributor.

Here, the sharing economy lets young, rich entrepreneurs live an insular life. "They can book a week-long stay in a cool apartment through Airbnb... or hire a luxury car anywhere in the city through the mobile app Uber... The hottest tech start-ups are solving all the problems of being 20 years old, with cash in hand, because that's who thinks them up."

Meanwhile, the resulting soaring house prices have caused a 20% rise in homelessness in the Bay Area. "After decades in which the country has become less and less equal, Silicon Valley is one of the most unequal places in America." So the creators of these 'sharing' platforms are certainly doing well out of it, but that doesn't seem to be trickling down to even those they live cheek by jowl beside.

However, there's no denying that, in many cases, consumers are doing extremely well from these deals. Technological innovation not only makes it easier for consumers to access services, it also opens up markets to increased competition.

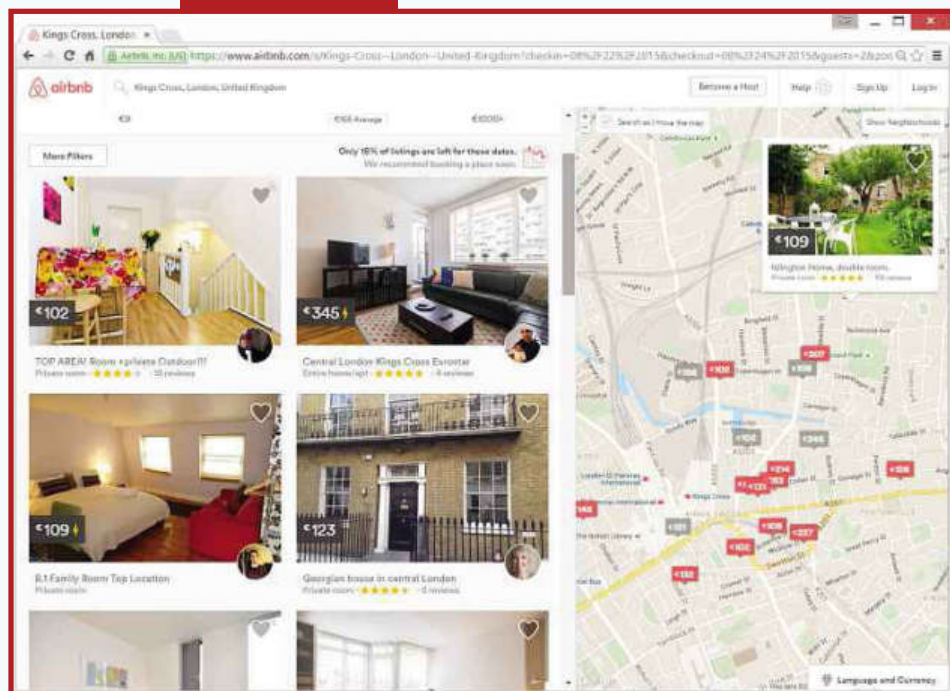
Five years ago, if we'd needed to commission a new logo, we might have paid a large sum to a professional graphic designer who we knew could deliver the goods, or we might have taken a punt on a cheaper designer. We might even have asked a friend to do it for free, and hoped that we wouldn't need to have an awkward conversation if it wasn't up to scratch.

WHO'S REALLY BENEFITING?

In short, these businesses stubbornly refuse to fit into pigeonholes. Although that doesn't mean there isn't a prevailing concept behind them all, the key of which is that most of the big-name sharing economy companies are really better described as software platforms.

These platforms attempt to centralise and dominate a certain area of the economy by connecting consumer with provider and skimming a percentage off the top. In short, these apps swipe away the existing industry and its middlemen, and provide instead a single, highly marketable destination for all your needs in that area. Just think what impact eBay has had on second-hand shops and boot sales.

In his 2013 article 'Change The World' for www.newyorker.com, George Packer describes how the Bay Area around San Francisco is teeming



TAXI HIRE

Today, we can put the commission on DesignCrowd, offer a relatively small sum – perhaps £250 – and within hours we'll have dozens or even hundreds of designs to choose from, submitted by designers from across the globe. These are all done on spec, so if we decide against them all we only pay the £45 commission to DesignCrowd. There's a "100% money back guarantee" splashed across the homepage, but the small print points out that posting fees aren't included in this offer. It's not hard to see how this business has reached a turnover of \$10 million in just six years.

WORKSHARE

Where does this leave those doing the work, though? On DesignCrowd, for example, we suspect there are amateur and student designers who are happy for the experience and the odd success. A few designers are raking it in. The highest earner has made \$842,000, with 11 more earning over \$100,000. However, of the 14,722 designers who have made any money from DesignCrowd, the one ranked 100 in the chart of high earners has made \$26,900 to date. The vast majority have earned only a couple of hundred dollars.

Creative professionals aren't known for their ability to organise themselves into lobby and protest groups. Cab drivers tend to be more outspoken. In June and September of 2014, they brought Whitehall to a standstill in protest against Uber. It wasn't so much the



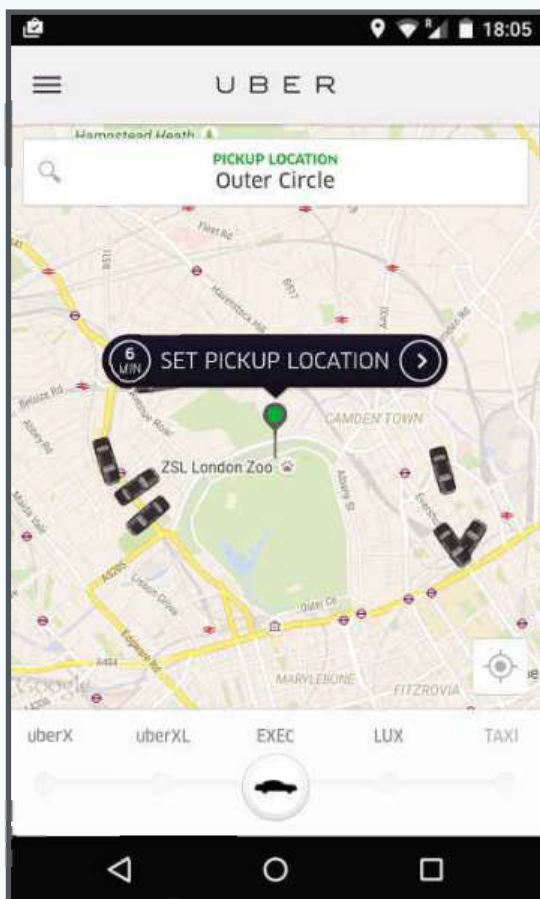
success of Uber they were upset with, though that's clearly part of it. It was the fact that Uber drivers don't play by the same rules, with no requirement for training and licensing. Uber is still going strong in the UK, and the company claimed an 850% increase in downloads of its app on the day of the June protest. In May 2015, mayor Boris Johnson announced that, with taxi licence applications down by 20% and minicabs up by 18% in a year, he was considering legislation in order to ease congestion on London's roads.

LBC's Nick Ferrari put it to Johnson that he should never have allowed Uber on to the streets of London. His response was that he had no legal choice. If it could be proven in the courts that Uber is effectively a metered taxi and breaking licensing laws, Uber would simply change its model. Steve McNamara from the Licensed Minicab Drivers Association pointed out that it's not just an issue of congestion. "Many of these drivers on these apps are having to claim tax benefits and credits to survive... funded by UK taxpayers, subsidising a \$40 billion company that doesn't pay a penny in tax in the UK."

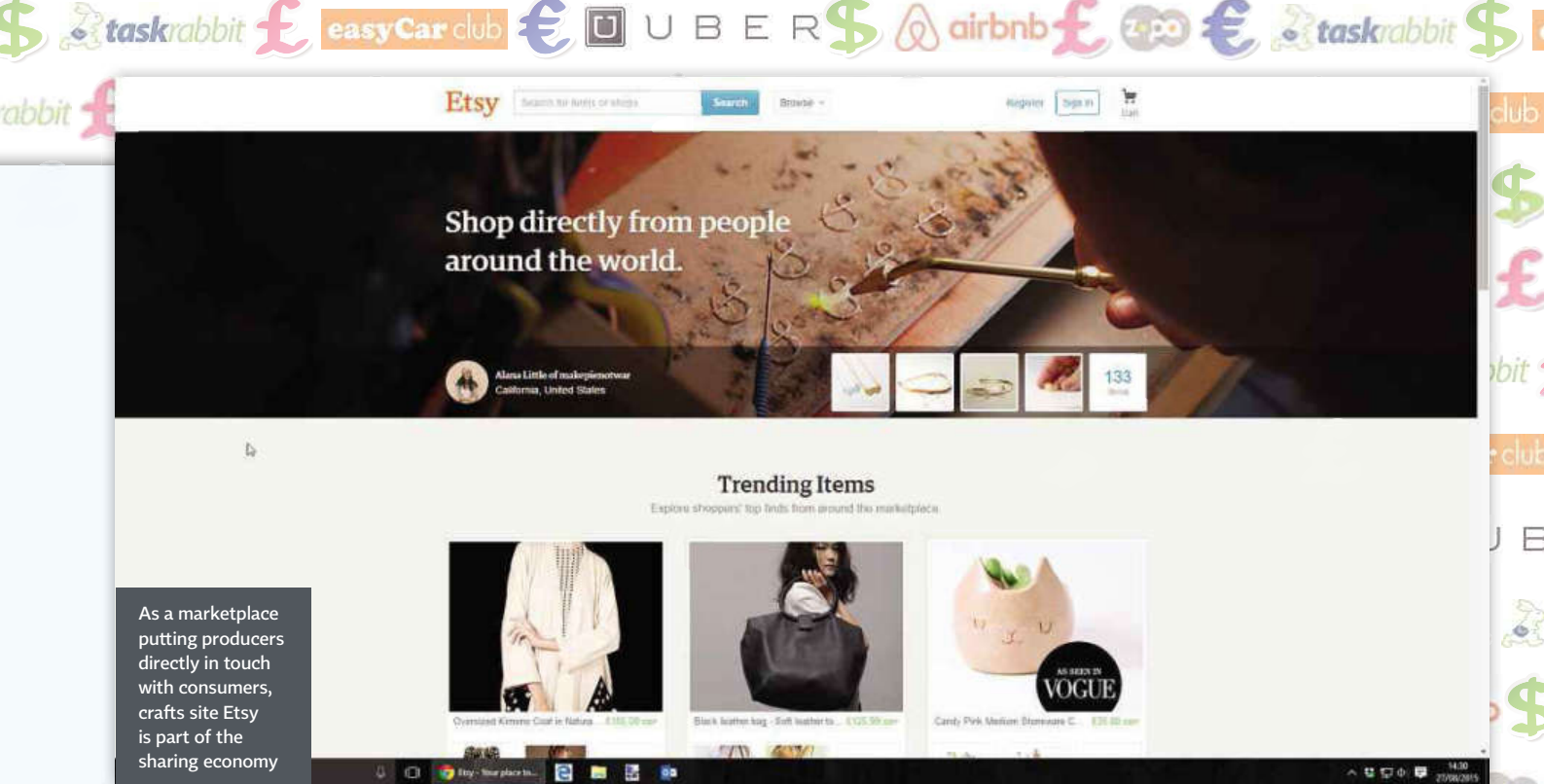
Uber's opponents have been more successful in Spain, where on 9th December 2014 a judge ordered that it cease all activities. It has also had a rocky relationship with regulators in various US states, but remains in operation. Back in the UK, the matter is due to be heard at the High Court on 5th October 2015. However, the court will only look at the issue of whether Uber's means for calculating fares constitutes a taximeter, which only black cabs are allowed to do. A decision against the company may force it to move to a fixed price model instead.

A SHARING, CARING FUTURE?

It's easy to pick holes, and the argument that the sharing economy disrupts current paradigms is weak. There will always be job losses when new business models prove more popular than old ones, and it's up to the existing businesses and workforces to adapt in order to survive. Is a car you can beckon with a smartphone better than a highly specialised vehicle that can turn on a sixpence and is being driven by someone with years of experience? The public will eventually decide, and perhaps there will be room for both.



Uber makes it incredibly easy to book a cab that's a just a few minutes from your current GPS position



However, when a new business model is more efficient, that means it requires less manpower to deliver a service. That might mean it becomes cheaper for consumers, freeing up their income to spend on other services. And that means bigger profit margins for the businesses that provide the services. That's particularly true for sharing economy services, where their overheads per transaction are tiny.

The future looks bright for the small number of companies that can achieve critical mass and dominate their chosen field. Efficiencies aren't always so good for labour markets, though, at least in the short term. If it takes fewer people to deliver a service, this means fewer jobs and more competition for the remaining ones, which drives down wages.

We asked Rachel Botsman whether there's a danger that these businesses benefit the owners of the platforms and consumers at the expense of those providing the service. "Yes, we absolutely have to protect the providers on the platform to ensure that these marketplaces do not suffer from race-to-the-bottom of wages. If this happens, it will just accelerate social inequality and these marketplaces will become sources of cheap labour people. But there are ways to stop this from happening such as setting minimum rates providers have to earn."

Notwithstanding these risks, there are benefits to sharing economy platforms for service providers. Unlocking idling capacity is a clear example where all three parties benefit. Time banks, where people swap volunteering time for credits, is a potent force for building communities. They could also help people back to employment without cutting their benefits.

Working for peer-to-peer services such as TaskRabbit and Uber lets people choose their own hours, perhaps around childcare or other responsibilities. These services remove some of the barriers to self-employment, which – in theory at least – could mean a better wage compared to working for a traditional employer.


These platforms also make it easier for workers to be versatile. If you're registered with Uber but having a quiet month, you could try your hand at office removals, logo design or any number of other jobs. This kind of

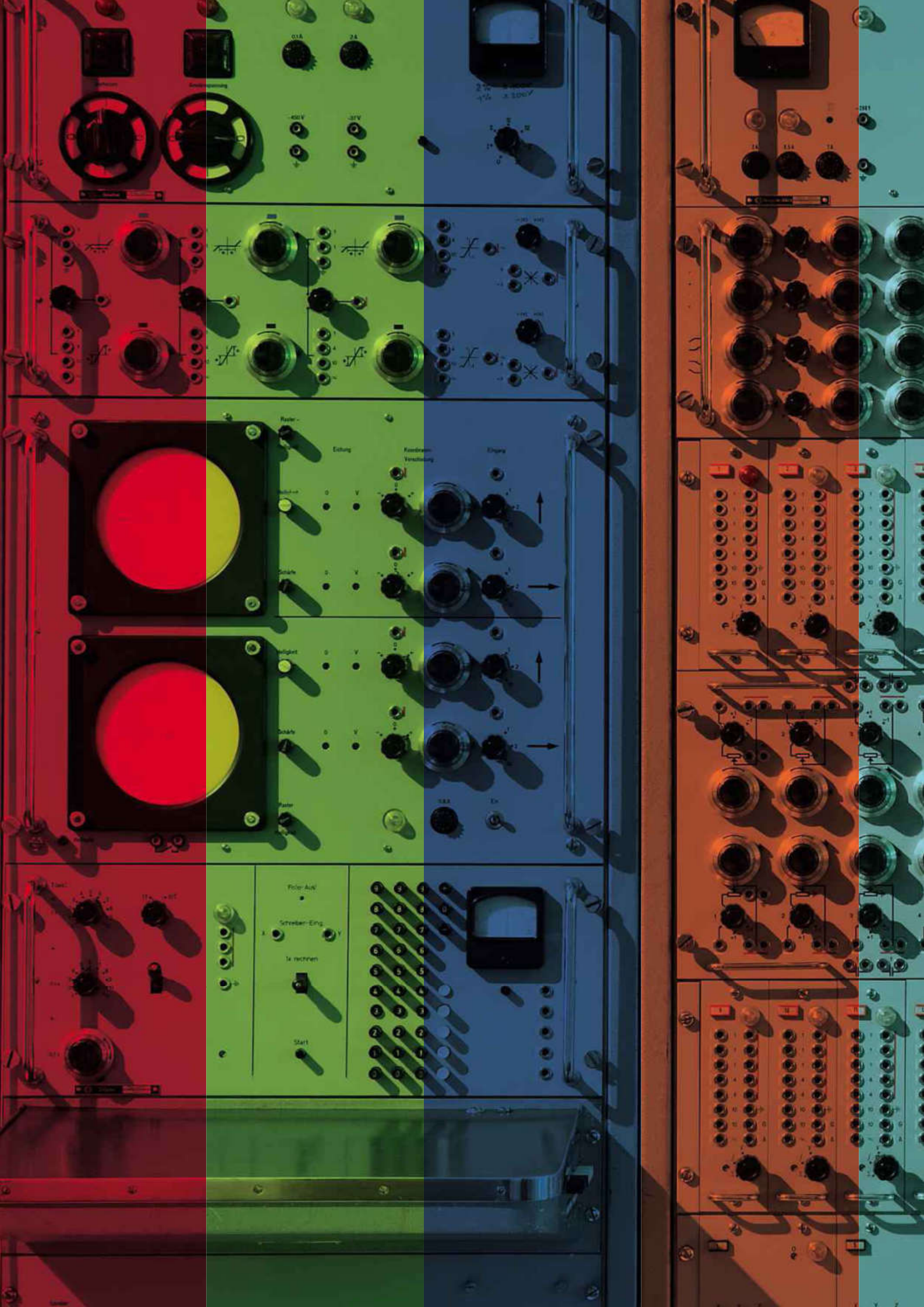
labour market fluidity is the stuff of dreams for chancellors trying to get the economy moving again. Not everyone wants a life flitting between insecure jobs, but it might work for some people, and having multiple saleable skills is a great asset in a fast-moving economy.

A COMPLEX REVOLUTION

The sharing economy showed great promise because it played to people's self-interest for a better deal, and almost as unintended consequences it built communities and reduced demands on natural resources. Those benefits may well prove to be accurate. Ultimately, though, the sharing economy is as good, bad, complex and confusing as any other major technological or economic revolution. The internet has transformed the world beyond recognition in just 20 years, giving us better access to the best and the worst of humanity. There's no going back, though, and we suspect most people wouldn't want to.

The sharing economy showed great promise because it played to people's self-interest for a better deal

The same looks set to be the case with the sharing economy. Their decentralised structures mean these companies can grow incredibly quickly, and there will undoubtedly be more unintended consequences. There will be winners and losers, and because it's played out on a global scale it's virtually impossible for governments to encourage the benefits without also attracting the drawbacks. That means it's down to consumers to vote with their wallets to decide which platforms deliver the greatest benefits to the largest number of people. If Uber, Airbnb and TaskRabbit end up as big and powerful as Google, Facebook and Twitter, perhaps we'll be grateful to have six mega-corporations jostling for power, rather than just three. 





Analogue COMEBACK

Could analogue computers really be on the way back, ready to give their digital counterparts a run for their money?
Mike Bedford finds out

To say that the words 'digital' and 'computer' are inseparably linked may sound self-evident, but history tells a different story. Some of the first computing devices employed analogue techniques and, in certain applications, the electronic analogue computer held its own for many years after digital techniques had become established.

Of course, history goes on to show that digital technology eventually triumphed, but a recent move by America's Defense Advanced Research Projects Agency (DARPA) suggests that analogue computing isn't dead yet. And you'd be brave to bet against this forward-looking organisation, which was instrumental in the birth of the internet itself.

In March this year, DARPA invited the research community to provide their ideas for advanced computing techniques that will accelerate computer simulations or, as they put it, to bring petaflops to the desktop. Nothing surprising there, you might think – except that the methods they have in mind are a throwback to the days of analogue computing.

DARPA believes analogue tech is what's needed to tame problems too challenging for even today's digital processors, from modelling climate change to the spread of an epidemic. With such an august body lending its support to analogue computing, it would be foolish to ignore its potential. Accordingly, we've scoured the world of computer research to discover who's doing what in this long-forgotten realm of computing, and to find out if analogue really does have a future to rival its past.

Analogue vs digital

Before we can start to understand what analogue computing might look like in its 21st-century guise, it would be helpful to turn back the clocks to see the technology as it stood in its heyday of the 1960s and early 70s.

In general terms, most of us know that digital computers store and manipulate information as binary numbers. So, in a simple 8-bit processor, the value 40, which has the binary equivalent of 00101000, would be represented by eight voltages which, in the case of a 5V supply, would be 0V, 0V, 5V, 0V, 5V, 0V, 0V and 0V.





Analogue computers of the 1950s, 60s and 70s were programmed using patch leads to form a circuit

In an analogue computer, that same value would be represented as a single voltage, perhaps 40V, although the actual value would depend on the scaling. As a simple example, it would then be possible to route this voltage to one of the inputs of an analogue 'summer' (or summing) circuit, and route 20V (representing the value 20) to another input, to calculate the sum of these two values, which would appear at the output as 60V.

Calculations involving simple arithmetic wouldn't have been a very good use of an analogue computer, but other areas were its forte. Many real-world systems – the weather or the aerodynamic characteristics of a Formula One car, for example – are defined by differential equations. These dictate the rate of change of the variables in the system – perhaps temperatures or air pressures in the case of the weather.

To simulate such a system, and thereby discover how it would behave under various conditions, it's necessary to solve those differential equations. This involves a mathematical process known as integration, and this is where analogue computers really shone.

A simple analogue electronic circuit, known as an integrator, was used to perform this function and, crucially, the time it took to

do so didn't depend on the complexity of the system. With a digital computer, however, solving differential equations is a notoriously computer-intensive task, and the more complicated the system, the longer it takes. Potentially, therefore, a difficult problem that might be solved in a few seconds on an analogue computer might keep a digital supercomputer busy for hours.

Advantage over

With such a compelling advantage it may seem hard to believe that digital techniques eventually triumphed, but we've only seen part of the story. Despite their speed, analogue computers had serious drawbacks. It's largely true that any digital computer can solve pretty much any problem it's set, and a desktop PC differs from a supercomputer only in the speed at which it can do so.

This isn't true of an analogue computer. Since each differential

equation in a model requires at least one integrator, the number of integrators in an analogue computer imposes a limit on the size of the problem it can solve. This means it's possible, if you were to further develop a model you were working on by adding a few more differential equations, that you'd outgrow your hardware.

A second major drawback is the ease of programming. With a digital computer, programs are entered on a keyboard and stored on disk so they can be easily accessed at a later date. With an analogue computer, programs are created by wiring up circuit elements such as summers and integrators, a process that involves plugging patch leads into sockets on its front panel. While many analogue computers had removable front panels, so the programming could quickly be changed, there's a limit to how many of these expensive and bulky panels could be maintained.

This being the case, returning to an old program could well involve patching it up again from scratch.

Finally, as long as you don't mind it taking longer, with a digital computer you can be as precise as you need. An analogue computer is limited to the accuracy of its analogue building blocks, so you may have to settle for an approximate solution.

The upshot of all this is that analogue computers became marginalised to solving particularly difficult problems. As digital computers became progressively faster, though, the cut-off point between digital and analogue territory changed. Eventually, it was deemed that no problems were so fiendishly difficult that the inconvenience of analogue computing was a price worth paying, and the analogue dinosaur was consigned to history.

Forty years on, and DARPA thinks this might have been a premature decision. If given the facelift that today's technology allows, analogue techniques might once again shine where digital struggles.

Analogue for today

DARPA couldn't make anyone available for interview for this feature and, as yet, it's unclear whether any research groups are

**A PROBLEM THAT KEPT A DIGITAL
COMPUTER BUSY FOR HOURS
MIGHT BE SOLVED IN SECONDS ON
AN ANALOGUE COMPUTER**



Analogue computers could consume far less energy than today's power-hungry digital supercomputers

working on a response to the organisation. However, the idea of bringing analogue computing up to date, perhaps by merging it with digital techniques, is not a new one. Indeed, as its last gasp before extinction back in the 1970s, the analogue computer had already benefited from linking up with its digital counterpart.

The so-called hybrid computer was essentially an analogue computer under the control of a digital computer. So the digital computer could start and stop the analogue computer and could read the results of its computations, via analogue-to-digital converters, so those results could be displayed in a more user-friendly fashion than on a voltmeter or a chart recorder.

Most importantly, they could also adjust the analogue computer's potentiometers. In plain English these components are the same ones that were used as volume controls in pre-digital radio receivers, and were used in analogue computers to multiply a signal by a constant value. Commonly, analogue computers were used to home in on the solution to a problem by running the program, adjusting the value of a potentiometer depending on the result, running it again, and continuing until the solution was found. This sort of optimisation

problem could be solved much more quickly under digital control.

Digital computers were also starting to be used for working out the program for an analogue computer. This way, the model was entered into the digital computer as a series of differential equations and the digital machine would work out how the various analogue summers, integrators and potentiometers should be patched up to solve the problem. The leads still had to be plugged in manually, but today's digital techniques could do much more.

Certainly this is the view of Glenn Cowan, associate professor in the Department of Electrical & Computer Engineering at Concordia University in Montreal, who 10 years ago set himself the task of finding out if analogue computers could be revived using today's semiconductor fabrication techniques.

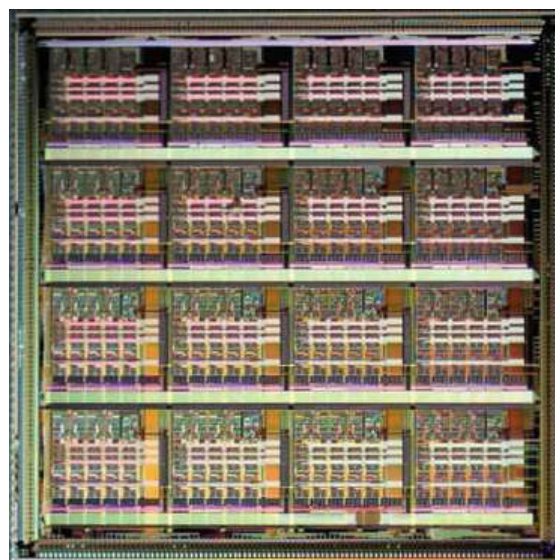
Chip shape

The result of the work was a chip containing both analogue and digital circuitry that could be used as a co-processor to a digital

computer. On-chip were 416 functional blocks, including 80 integrators, plus a large number of electronic switches that allowed the functional blocks to be connected under digital control, as required by the application.

Cowan showed that the analogue chip could provide a 400-fold speed advantage compared to a high-powered UNIX workstation and would, typically, consume between 0.02% and 1% of the power. Digital computers have become faster in the past decade, but the analogue chip was designed by a single person as a PhD project, so the prospects for major improvements would seem to be good. So why has this work gone largely unnoticed, with little sign of other research teams following up on this promising glimpse of a possible future for analogue computing?

Cowan suggested this analysis isn't quite correct in that analogue circuits are undoubtedly being used today, but are hard-wired for particular jobs, instead of providing a general purpose capability. "We continue to see activity in application-specific analogue processors," he told us, "for example, analogue decoding of communications codes and pattern classifiers." However, he also envisages a future for more



◀ Prof Glenn Cowan's chip combines both analogue and digital elements

universal analogue circuits, even if there are challenges ahead.

"In brief, analogue has promise for medium- to low-resolution computation", he said. "Balancing reconfigurability against performance is a challenge." Since his chip seemed to have addressed the issue of reconfiguration, certainly compared to analogue computers of old, that seems a perplexing suggestion.

According to Cowan, though, the problem lies in the laws of physics. "In the chip I designed, each circuit within the macro block could be connected to one another through one level of switches. However, the switches have a small effect on the signal, both in terms of the series resistance and their parallel capacitance. Knowing the level of these 'parasitics' we operated the computational circuits slowly enough that they only have a small effect. If the parasitics were smaller we could run the circuits faster.

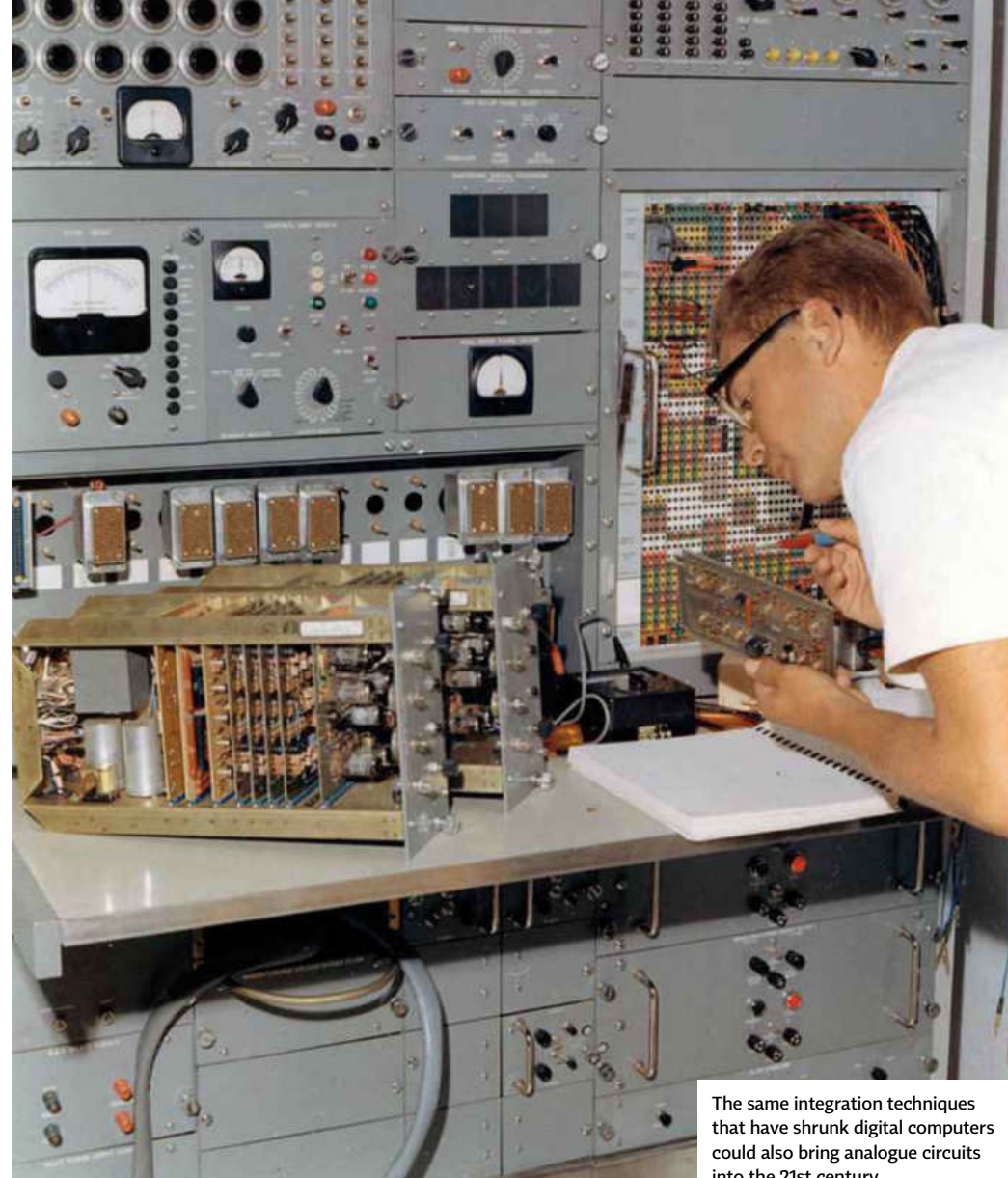
"To get from a circuit in one macro block to another we had to go through more switches, which would degrade the signal a little more. If we had put all the circuits in one flat connection scheme, we would have had more parallel capacitance on the signal wires, requiring even further reduced circuit speed. If we restricted connectivity more, we could have less impact from switches."

This goes to show that maybe electricity isn't the best medium for analogue computing, especially if you want the kind of speed and accuracy we're used to today from digital computers. But there are other options, such as light.

Optical integration

Although we've been thinking about analogue computers in the electronic sense, analogue computation hasn't always used electronic circuits, so there's no reason to believe that other technologies can't have a role in future analogue computers. As a case in point, scientists at the University of Pennsylvania, the University of Texas at Austin, and the University of Sannio in Italy have demonstrated the potential of optical metatronic materials.

These materials manipulate light waves as they pass through them almost instantaneously. However, it's not just a matter of finding suitable materials for a given job; instead they have to be



The same integration techniques that have shrunk digital computers could also bring analogue circuits into the 21st century

designed specifically to perform a particular operation. This involves making patterns of multiple materials at scales smaller than the wavelength of light; which might theoretically be achieved by embedding a series of nanoscopic gold cubes in glass.

To date, the research has involved computer simulations of these materials, but their potential for carrying out mathematical functions such as differentiation and integration – the bedrock of analogue computing – has been clearly demonstrated. With an ideal metamaterial having proved its worth, the team proceeded to simulate structures made from materials such as silicon and aluminium-doped zinc oxide, which are compatible with today's fabrication methods.

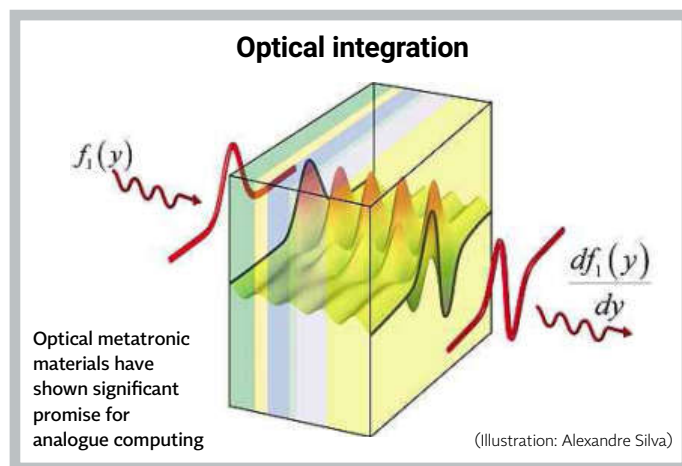
According to the principal investigator, Pennsylvania's Prof Nader Engheta, "the simulation results of the two were almost identical, so we're hopeful we'll be able to do photonic calculus in a physical experiment in the future".

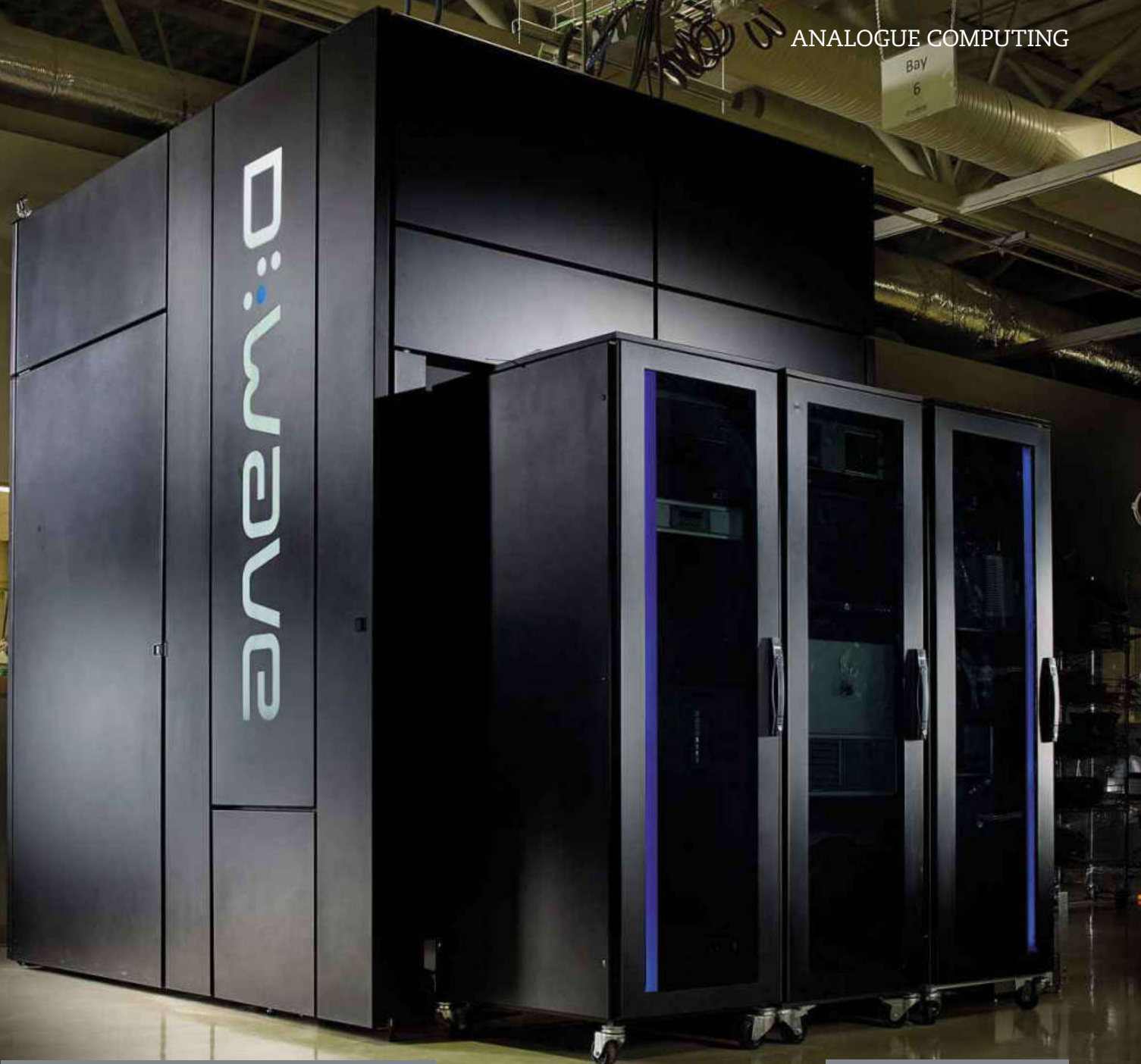
What's more, Engheta has plans for this to become a truly universal computing architecture. "Regarding the possibility of extending our idea of metamaterial-based analogue computing to 'general purpose' computing and processing, one possible way would be to consider tunable and reconfigurable metamaterials. In such a scenario, we can envision that one will use

some material structures that can be changed and 'reconfigured' at will in order to perform different mathematical operations.

The neural approach

Previous analogue computers were based around circuits such as summers and integrators, and new research into optical methods suggest that any such technology would adopt a similar paradigm.





A quantum leap?

Canadian company D-Wave claims that its \$10 million creation is a quantum analogue computer

The race to produce a universal quantum computer has been a long one and, as yet, it appears we're still some distance from the finish line. Quantum computers exploit a strange-sounding effect that occurs in the sub-atomic realm, in which tiny particles can be in two places at once or in two different states simultaneously.

This means that, in addition to storing the zeros and ones of conventional digital computers, they can store ones and zeros at the same time – a phenomenon known as superposition – as so-called qubits. This way, instead of storing a single value, a 64-bit register of qubits could store all the possible nine billion billion values simultaneously. Any operation carried out on that register would act on all those values at once, resulting in massive parallelism. Attempting to read the results is problematic because doing so causes just one qubit to be read at random, but clever algorithms have been designed to exploit this counter-intuitive phenomenon.

The snag is that superposition is notoriously difficult to maintain, as any interaction with the environment will cause it to collapse. What's more, as the number of qubits increases, so does the difficulty of maintaining superposition. The upshot of all this is that the largest digital quantum computers that have been demonstrated

in academia have registers no wider than the microprocessors of the 1980s. Given that the number of simultaneous values a quantum computer could hold rises exponentially with the number of bits, and that an 8-qubit device could hold just 256 values, this is a far cry from what can be achieved from the 64 bits of today's PCs. So the announcement by Canadian company D-Wave Systems in 2011 that it had created a commercial 128-qubit computer (a value that has since increased to 512 qubits) caused the odd eyebrow to be raised in the research community.

To cut a long story short, there's been a long dialogue between D-Wave and its critics, some of the most vociferous of whom went so far as to suggest the company was acting fraudulently. The debate continues as to whether the D-Wave system really does exploit quantum effects, but one thing is sure – it isn't a universal digital quantum computer. Instead it employs a technique called quantum annealing. The maths from here on gets tricky, to say the least, but the pertinent point is that it can be thought of as a quantum analogue computer that's intended for optimisation problems. Perhaps, therefore, any return to the age of analogue computing could come from this brain-twisting direction.

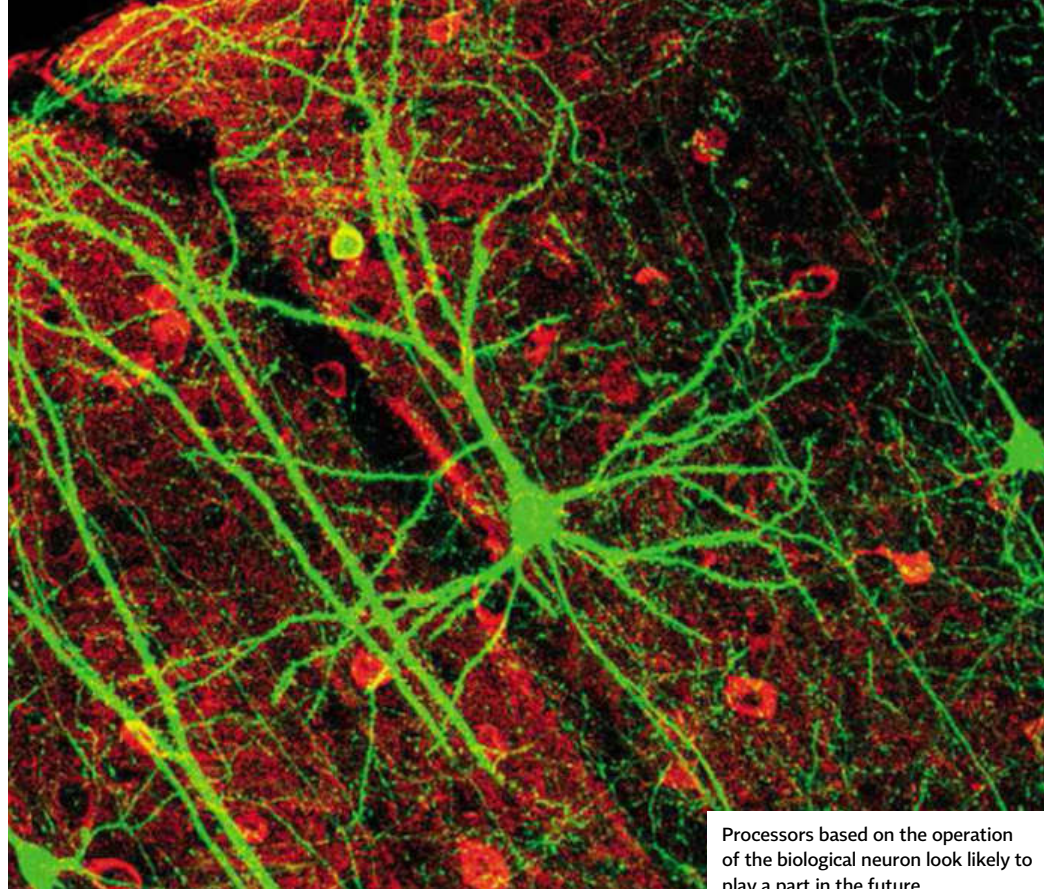


However, much of today's research into analogue computation involves an architecture that has never previously formed the basis of mainstream computers.

Neural networks are composed of processing elements that mimic the human brain and have been the subject of research for many years. Each processing element, which is the equivalent of a neuron in a brain, couldn't be much simpler. It generates a pulse on its output if sufficient pulses are received on its inputs.

Where the power comes from is in their vast number and the hugely complicated network of interconnections between them. The human brain, for example, is estimated to have 100 billion neurons, each of which has 7,000 connections to other neurons. Indeed, this requirement for vast numbers of criss-crossed connections has been one of the main reasons why they haven't been produced, to any great extent, as silicon chips don't readily lend themselves to this sort of configuration.

Despite this difficulty, though, neural networks could excel where



Processors based on the operation of the biological neuron look likely to play a part in the future

digital computers struggle, in tasks such as facial and voice recognition. Admittedly digital computers have come on in leaps and bounds in these applications in recent years, but the frustrating experience of trying to use

automated phone systems with voice recognition is testimony to how far they are from being able to do what humans do with ease.

Check the pulse

In passing, we perhaps ought to address the question of whether a human brain, or an electrical circuit that operates in a similar way, truly is an analogue computer. After all, communication by pulses does seem to have digital connotations. True, neurons don't communicate using continuously varying

voltages, which is how we've defined analogue computers but, on the other hand, they most certainly don't calculate in binary, which is our usual definition of a digital computer. The bottom line is that our brains have characteristics of both analogue and digital models of computation, although some artificial neural network researchers have suggested that a similar model of computing can, indeed, operate using genuinely analogue circuits.

Electrical engineers at the Georgia Institute of Technology

NEURAL NETWORKS COULD EXCEL WHERE DIGITAL COMPUTERS STRUGGLE, IN TASKS SUCH AS FACIAL AND VOICE RECOGNITION

The popular analogue computer

The electronic analogue computers of the 1950s, 60s and 70s were hugely expensive. Although a few small-scale models intended for educational use cost several hundred pounds – still a not insignificant amount – a full-sized analogue computer would cost tens of thousands. However, analogue calculating devices that truly were cheap enough for anyone to own were popular among the more technically minded before the electronic calculator made its appearance.

Made famous in the BBC election coverage of 1955, where they were used by an army of boffins to predict the outcome, this was the slide rule: a mechanical analogue calculator for carrying out multiplications and divisions. To see how it works, let's start by thinking about addition and subtraction. Analogue calculators didn't perform these functions because it was assumed that they

could easily be done by mental arithmetic, but it helps us to understand the slide rule.

Imagine taking two ordinary rulers that measure in centimetres and millimetres and put them one above the other. Slide the top ruler so that its zero point is next to 25mm on the bottom ruler. Now go to 20mm on the top ruler and read off the corresponding value from the bottom ruler. You'll find it's 45mm, the sum of 25mm and 20mm, which is hardly surprising given that you're just adding together two lengths. You can do something very similar for subtraction.

A slide rule works in the same way, except that the end result is the product of the two numbers (the two multiplied together) instead of their sum. That is because a slide rule has a logarithmic scale instead of the linear scale used for measuring, and adding logarithms results in multiplication.



are confident that neuromorphic computing, as they prefer to call this technology, has the potential for huge power savings. As an example, the human brain consumes just 20W of power, while it's estimated that a digital computer of equivalent power would require a hundred kilowatts of electricity. Working on the assumption that electronic analogue computers could be more efficient than the human brain, their expectation is a 10,000-fold improvement compared to digital computers.

If you have a PC that costs you just a few pounds a year to run, such an improvement in efficiency won't really save you a lot of money so you might be inclined to wonder what all the fuss is about. However, in the upper echelons of computing, things couldn't be more different, as a look at the world's fastest supercomputers will reveal.

China's 80,000-processor, 3.13 million-core Tianhe-2, which is used for exactly the sorts of applications where analogue techniques could excel, consumes 17,808 kilowatts. This is a whole 1% of the output of many of the UK's largest power stations, or enough electricity to power 17,000 homes – it would cost £15 million per year to run it on a British domestic tariff.

Doug Burger, a researcher with Microsoft's Extreme Computing Group, also believes that a model of analogue computing based on mimicking the behaviour of the brain might provide a solution when digital circuits can be shrunk no further. He asserts that we don't always need the accuracy

offered by digital techniques and, in these cases, an acceptable solution can be provided more quickly and with less power in the analogue domain.

Burger has demonstrated a means by which computer programs can be written in a conventional manner, but with the

programmer specifying which parts can tolerate a degree of inaccuracy. Those parts of the code that really do have to be handled with precision are executed normally by a digital computer but, where an approximate answer is considered acceptable, data is forwarded to artificial neurons.

To date, only single neurons have been used and, while these have used genuinely analogue signals instead of the spikes of biological neurons, the connections between them have been achieved digitally. In other words, digital data is converted to analogue signals via digital-to-analogue converters, the signals are passed through to a neuron, and the output is converted back to digital signals using an analogue-to-digital converters. If needed, this signal can then be routed to other artificial neurons and so on until a final result is obtained. While this doesn't make full use of the massive degree of parallelism offered by a neural

network, the potential for further development is self evident.

Analogue or digital?

We may not have come up with a definitive answer to the question of whether analogue computing has a future but, as the silicon dream starts to run out of steam, it seems likely that analogue will play a part in the future.

According to Microsoft's Doug Burger, though, it's not a question of analogue or digital, but of the two working together, with other technologies in the mix too. As well as today's digital processors, we could add dedicated logic circuits that work in the digital domain and, alongside traditional analogue and neural concepts, quantum computing, chemical techniques and cellular automata might also get in on the act.

As Moore's Law eventually fails, and unending performance gains in digital computers comes to an end, it appears we might see the dawn of an exciting new age of multi-faceted computing. **CS**

ANALOGUE COMPUTING



Corroded it may be, but archaeologists believe this 2,000-year-old mechanism was a genuine analogue computer

The 2,000-year-old analogue device

Discovered by sponge divers in a shipwreck off the Greek island of Antikythera in 1900, it took archaeologists and scientists decades to discover the true nature of the corroded mechanical device now known as the Antikythera Mechanism. Even though it dated back to at least 100BC, and despite nothing of similar complexity being created for well over another thousand years, it's now believed to have been the world's first computer, and an analogue one at that.

The device was hand-cranked and its purpose was to perform astronomical computations, showing information about the positions of the moon, sun and planets against a background of stars on the mechanism's display. To do this it had 32 interlocking gears, some of which were differential gears that would be able to carry out analogue addition. In that sense, it has more than a little in common with the large-scale mechanical analogue computers of the 19th and early 20th centuries.



Georgia Institute of Technology's Professor Jennifer Hasler (left) has designed an integrated circuit with biological-based neuron structures for power-efficient calculation

Can Cameron *really* filter



The government says it wants to restrict access to adult sites, but do we really have the technology to protect our children? **Barry Collins** finds out

Tough on porn, tough on the causes of porn. That's the message coming from Downing Street, where David Cameron is once again threatening to outlaw pornography sites that fail to apply robust age verification.

"I want to see age restrictions put into place or these websites will face being shut down," the Prime Minister declared recently, announcing a consultation on the matter that will be launched this autumn.

While the prospect of pornographers arriving in Downing Street for a chat with David Cameron is amusing, the problems facing the Prime Minister's porn blockade are much more serious. How can you effectively verify the age of website visitors without compromising their privacy or security? And what can Cameron actually do about the vast

majority of porn sites that are hosted overseas, beyond the UK's jurisdiction?

Failure of the filters

In some ways, Cameron's crusade against the porn sites is an admission that previous attempts to prevent children accessing adult content have failed. Two years ago, the government effectively blackmailed Britain's major ISPs into offering network-level parental control filters to their customers, threatening to legislate if they didn't do so.

At the time, Cameron presented this as a panacea, an instant solution to the problem of children accessing pornography and other harmful content. "All the ISPs have rewired their technology so that once your filters are installed they will cover any device connected to your home internet account; no more

hassle of downloading filters for every device, just one-click protection," Cameron said in a speech announcing the deal in 2013. "One click to protect your whole home and to keep your children safe."

Now 90% of Britain's broadband lines are covered by the filters on offer from the major ISPs, with some providers, such as Sky, now switching them on automatically unless the customer actively opts out. But it seems, for whatever reason, that parents simply don't want them. An Ofcom report in January this year found half of parents were aware of the network-level filters, but only 21% use them.

That should come as no surprise to the Prime Minister: the government's own 2012 consultation on parental controls found that there "was no great appetite among parents for the introduction of default filtering of the

internet by their ISP: only 35% of the parents who responded favoured that approach”.

Nanny state knows best

Still, Cameron wants to go even further. The Prime Minister says he wants to “curb access to harmful pornographic content which is currently far too widely available”, and has put forward suggestions for how this might be achieved, including primary legislation that makes it an offence to publish pornography without age-verification controls. We’re not talking about easily circumvented drop-down menus asking for your date of birth, but “proposals to block content through payment providers and other means”.

Forcing adults to hand over credit card or other payment details to access legal pornography could cause more problems than it solves, according to security experts. “My worry would be that we would start seeing a spate of phishing sites being created, using the lure of pornographic content,” David Emm, principal security researcher at Kaspersky Labs, told *Computer Shopper*. He said the sites would be able to steal valuable data “under the guise that we need your credit card details to verify you”.

Emm is also worried that legitimate (for want of a better word) porn sites would become a target for hackers, who would “install malware on a site to steal personal information”. As the recent breach of Ashley Madison (a matchmaking website for people seeking extra-marital affairs) proved, a huge database of people with something to hide can be used to blackmail users.

Emm suggests it would be better if ISPs, rather than credit card companies, were to verify the age of users every time they went online. ISPs already have your bank details, so there’s no increased risk, and they could act as the gatekeepers to adult content. “On first access to the internet, I’m required to enter a password that I set up when I first established an account,” Emm says. Children would have separate accounts, which would bar access to adult content, using existing filtering systems.

Whether the ISPs, who have already borne the cost of implementing the little-used parental control filters, would agree with Emm’s proposal is another matter.

Beyond our borders

Even if Cameron does succeed in forcing British pornography sites to implement an effective means of age verification, he has no

➔ David Cameron wants to restrict access to adult sites, but it’s doubtful that we have the technology or jurisdiction to do so



The Ashley Madison hack showed how hackers can blackmail adult site users

jurisdiction to force foreign-hosted sites to do likewise. According to research conducted by internet filtering firm Metacert in 2013, 60% of all pornography is hosted in the US, with only 7% of porn sites originating in the UK.

The government’s unsourced figures claim the UK’s top 10 adult websites account for 52% of all site views, but even if that is the case, that still leaves half of all porn views outside of the government’s jurisdiction. If tighter controls are imposed on British sites, porn seekers will surely migrate to the sites with fewer restrictions.

With no power to shut down these foreign providers, the government’s only option would be to force ISPs to block overseas porn, imposing unprecedented levels of internet censorship. “Cameron needs to clarify how he wishes to achieve his goals, given that most porn sites are hosted abroad,” says Jim Killock, executive director of the Open Rights Group. “To block them, the government would have to introduce a national firewall, which would censor sites for everyone, and would likely be widely circumvented.”

Indeed, the major ISPs already block access to child abuse images and illegal file-sharing sites for all of their customers, not only those who choose to switch on the filters, but even these measures are easily skirted. Users can still access banned sites using the Tor network, for example, and clones of banned sites pop up the moment a court orders them to be blocked. It’s a futile game of whack-a-mole that the authorities will never win.

There is no “one click to protect your whole home and to keep your children safe”, as the Prime Minister promised in 2013. Once more, his proposals are top-heavy on rhetoric, but short on solutions. **CS**

AGE VERIFICATION: The options

Credit cards

Users could be forced to enter credit card details before accessing pornography, even if the site doesn’t intend to charge users. The advantages of such a system are that credit cards are widely used, so setup charges would be minimal. The danger is that credit-card fraud would become more common, with users unable to distinguish between ‘legitimate’ and rogue sites. The huge user databases would also be a rich target for hackers looking to blackmail users. And it’s not beyond the wit of most children to write down mum or dad’s credit card details when they’re not looking.

GOV.UK Verify

The government has been testing its own ID verification service, GOV.UK Verify, to validate the identity of people accessing its online services. Once you’ve registered, you enter a verification code that’s sent by email, mobile or a call to your landline, but you only have to do that once. The downside is that it can take up to 10 minutes to perform the initial registration, and up to a minute each subsequent time to verify who you are. Many people would also be nervous about having the government log their visits to adult sites, and it’s unlikely porn site operators would want to work with the government, or vice versa.

Two-factor mobile authentication

Mobile phone companies already know who is and isn’t over 18. If you had to enter a code sent to your phone every time you attempted to access an adult website – like the two-factor authentication systems used by Google, Microsoft and others – it could prevent children getting easy access. The downsides? Few would want to enter their mobile number into an adult website, and there’s a high risk of spoof and phishing attacks that could leave users compromised.

RUN LINUX ON YOUR CHROMEBOOK



Chrome OS is a great, but limited, operating system, so why not get more out of your Chromebook by installing Linux on it? Our guide shows you how

THERE ARE MANY reasons you might want to install a Linux distro on your Chromebook. You might have an application you can only run in Linux, you might want to play games on Steam (if you have a higher-end Chromebook with decent specifications) or you simply might want a wider range of applications than Chrome OS can provide. The good news is that installing Linux is very easy thanks to the open-source Crouton tool. The great thing about this method is that you keep Chrome OS and can instantly switch between your Linux and Chrome OS operating systems, without having to boot into them separately.

Limitations

Before we go any further, there are naturally some limitations that should be discussed. For a full list of pitfalls and potential problems, read the Crouton Readme file.

Every Chromebook model is different, meaning there might be hardware incompatibilities and other bugs. We would therefore recommend that you have some experience of Linux before you begin, although it's not mandatory; it will just help you understand the jargon used in Linux forums. In addition, Developer Mode, which you need to use on your Chromebook, is

insecure, meaning your laptop is more vulnerable to exploits and attacks.

How to install

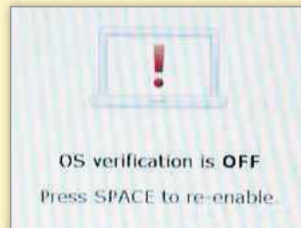
Installing Crouton is very simple, although your experience may vary depending on the Chrome OS device you're currently using. We carried out our testing on an HP Chromebook 11 from 2013.

Before you start, ensure any local files on your Chromebook are backed up. Anything else, including installed apps, extensions and Google Drive files, are stored in the cloud, so you don't have to worry about losing them.

STEP1 PUT YOUR CHROMEBOOK IN DEVELOPER MODE

First, make sure your Chromebook is switched off (not asleep). Hold down the power button until you're logged off, and then hold it down again until the screen fades to white. When you switch it back on, hold the Power, Refresh and Esc keys down at the same time.

You'll be presented with a warning about your Chrome operating system being damaged. Ignore this and press Ctrl-D. Your Chromebook will now be wiped and Chrome OS will be installed in developer mode. This process will take a few minutes to complete, and you'll need



to sign in and re-sync all your Chrome OS data when you eventually log back on again.

Every time you restart your Chromebook from now on (unless you factory-reset it), it will warn you about being in developer mode. This warning will persist for 30 seconds. Don't press the space bar as instructed, as this will wipe your device and you'll have to start again. Instead, hit Ctrl-D as above to skip the warning. You can avoid this by simply putting your Chromebook to sleep (by closing the lid) when you're not using it, instead of shutting it down fully.

STEP2 DOWNLOADCROUTON

Now you need to download Crouton, the tool that allows you to install Linux distros on your Chrome OS device. Head to the Crouton GitHub page at tinyurl.com/333crouton and click on the link labelled Chromium OS Universal Chroot Environment. By default, this should go in your Downloads folder.

STEP3 INSTALL YOUR LINUX DISTRO OF CHOICE

01 Press Ctrl-Alt-T at the same time to open a Crosh Terminal. This is the place you'll type in commands that will allow you to install a Linux distro on your Chromebook. Note that commands in Terminal are case-sensitive.

02 Type 'shell' and press Enter, then type 'sh -e ~/Downloads/crouton -t list' and press Enter. This will show you a list of supported 'targets', which are programs and Linux distros you can install using Crouton. In this example, we'll be using Ubuntu Unity Desktop, which is the most user-friendly, albeit fairly heavyweight, Linux distro. The Unity Desktop version also includes a few commonly used applications.



03 Type 'sudo sh -e ~/Downloads/crouton -t unity-desktop' and press Enter. Alternatively, replace 'unity-desktop' with another distro if you'd prefer. Crouton will download and install all the files for the distro you selected.

Depending on which distro you pick, this could take a while; Unity Desktop is roughly 1.1GB, for example. We shall now refer to this OS as a Chroot, which is the official term for the OS that Crouton creates, running alongside Chrome OS.

```
Welcome to crosh, the Chrome OS developer shell.
If you got here by mistake, don't panic! Just close this tab and carry on.
Type 'help' for a list of commands.
crash> shell
chronos@localhost / $ sudo sh -e ~/Downloads/crouton -t unity-desktop
```

STEP4 RUN AND ENHANCE YOUR CHROOT


01 Once the installation has finished, you should see a few paragraphs of text entitled, 'Here's some tips'. If you see this, the installation is done. To run your new Chroot, type 'sudo startunity' and hit Enter. Replace 'unity' with the name of the distro, if you chose a different flavour of Linux.

02 Your Chroot runs alongside Chrome OS. It can be accessed by pressing Ctrl-Shift-Alt-Back (not the left arrow key or the Backspace button, but the Back button next to the Esc key). To get back to Chrome OS at any time, press Ctrl-Shift-Alt-Forward.

03 You should now see your new Ubuntu desktop. Note that the top row of keys on your keyboard don't perform the function they're labelled to do. In Ubuntu Unity, this is easy to solve. Go to Settings on the left, select Keyboard and click the Shortcuts tab. Volume up, down and mute can be found and edited in the Sound and Media category. The Maximise Window key is in the Windows category, while the Window Switcher button may be occupied by the Switch applications command, found in the Navigation category.



04 The brightness and refresh buttons will require you to install Xdotool. This isn't difficult, but requires a couple of extra steps. Press Ctrl-Alt-T to open a Terminal window. Type 'sudo apt-get install xdotool' and press Enter. When prompted, press y and press Enter.

05 Go back to the shortcut keys menu. Press the small '+' button at the bottom of the window to add a custom shortcut. Name each custom shortcut Refresh, Brightness down and Brightness up for easy recognition. For refresh, type 'xdotool key ctrl+r' and press OK. Then click Disabled and press the refresh button. Repeat for Brightness up and down but replace the commands with 'xdotool key XF86MonBrightnessUp' and 'xdotool key XF86MonBrightnessDown' respectively. If this doesn't work, a simple workaround is to switch back to Chrome OS, lower or increase the brightness there and then switch back to Ubuntu again. 



LOST YOUR CHROOT?

If you ever log out of your Chroot or switch off your Chromebook, you'll need to restart your Chroot by following the run instructions as above.

Amazon



The streamed version of *Star Trek Into Darkness* (top) has worse image quality than the Blu-ray version (bottom), but it's a close-run thing

Blu-ray



Blu-ray *vs* streaming

Which has the best quality?

Blu-ray is supposed to offer the best quality for film buffs, but does that claim stand up to scrutiny? We pitch the online services against it to find out

Online video streaming services are the easiest and most convenient way for people to get the latest movies. When it comes to renting, streaming is often the only option. While convenience is important, we wanted to find out what you might lose along the way, so we used our HDMI capture kit to find out how Blu-ray stacks up against its online rivals and if the disc is still the best format for those who really want the best quality.

Our testing kit allows us to grab raw footage from any HDMI-enabled device, letting us compare the actual quality, with no image correction or processing applied. For this test we captured footage from a PlayStation 4, using it for Blu-ray playback and for the most common video-streaming services. Using the same device means that any quality differences are down to the services, not different processing from different playback devices.

THE RAW FACTS

Before we get into the testing, it's worth looking at the specifications for Blu-ray and streaming services. On paper, Blu-ray is the winner, with support for video encoded using H.264 at a resolution of 1,920x1,080, delivered at a bit rate of up to 40Mbit/s.

Compare that to Netflix, which is representative of other streaming services. It also uses the H.264 codec at a resolution of 1,920x1,080, but streams at around 12Mbit/s

maximum. That's a big difference. To get its streaming rate down, Netflix has to throw away more detail in its video stream compared to Blu-ray.

There are a couple of caveats. The Blu-ray figures are maximum bit rates, not a required amount. Some discs are encoded at lower bit rates, reducing quality, but allowing a film to fit on a single disc. This is the reason that quality can vary on Blu-ray. Even so, on average, a Blu-ray film will use higher-quality video than a streaming service; but the question is, can you really spot the detail that's lost?

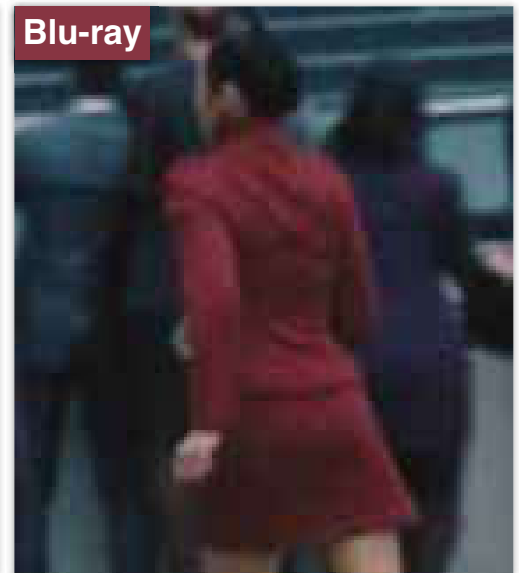
TESTED IMAGE QUALITY

The top streaming services we tested all performed well, with a detailed Full HD picture we were more than happy with. When we fired up Blu-ray and started looking at the differences, we noticed that they're very subtle, but the disc-based format is better.

In our sample shots, comparing the Blu-ray version to that from Amazon Instant Video (one of the best services we've tested), you start to see some differences. In particular, the Blu-ray frame is sharper throughout, while Amazon (and all the other streaming services) look a little soft in comparison.

Fine detail is removed from the streaming services, too. Look at our close-up of Benedict Cumberbatch from *Star Trek Into Darkness* (opposite), and you can see his hair and face are sharper and more defined in the Blu-ray version. As you look further into the distance, the differences are more pronounced: the guy on the left's jacket loses its padded detail, and the face of the woman in the brown dress has less detail in the streamed version.

Switching to a different part of the scene, you can see that the lady in red's dress has less detail in the streaming version, losing some of its creases and finer detail. Colour from the Blu-ray version is better across the



On Blu-ray the lady's jacket has more detail in the folds, and her skirt has texture rather than being one colour

entire frame, with the streaming versions often looking a little drab in some areas.

All of this might not seem like much, but the combined effect when the film is in full motion is much more. In short, the Blu-ray version looks sharper, cleaner and punchier. It's a cumulative effect, where if you watched the Blu-ray version of a film and then switched to the streamed version, you'd notice that the latter wasn't quite as good.

SOUND QUALITY

This is one area where Blu-ray is ahead of the pack. Most streaming services offer at least Dolby Digital 5.1 surround sound, if not Dolby Digital Plus 7.1 sound (on some programmes and films), but sound is compressed using lossy compression, which means that some detail is lost. Blu-ray supports Dolby TrueHD and DTS-HD Master Audio, both of which are lossless and of a higher quality. In addition, the vast majority of discs use these formats, making Blu-ray a better choice for people that want immersive surround sound.

4K AND THE FUTURE

Streaming services have the advantage here, with Netflix and Amazon streaming in 4K, with a select group of applications. It requires a lot more bandwidth, with Netflix recommending a staggering 25Mbit/s for Ultra HD broadcasts. Streamed 4K content looks better than Full HD content from Blu-ray, for now. The limitation is that the streaming 4K format requires an H.265 – also known as a High Efficiency Video Coding (HEVC) – codec built into the receiver. This codec gives you better quality at a lower bit rate, but the downside is that video requires about three times the processing power as it does for H.264 and Full HD. As such, it's not possible to just add HEVC decoding to existing devices, limiting the availability of 4K streaming to only the latest TVs for now.

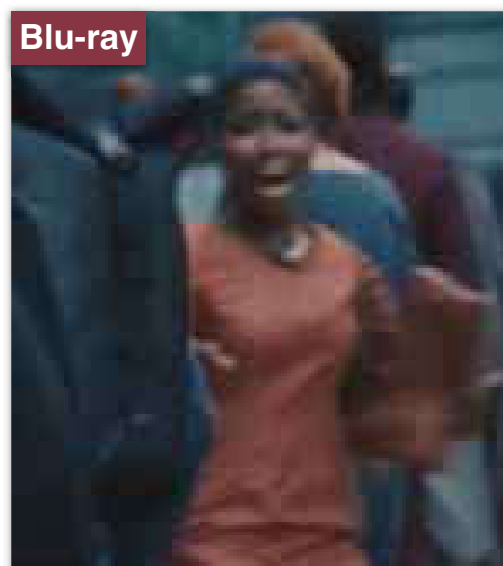
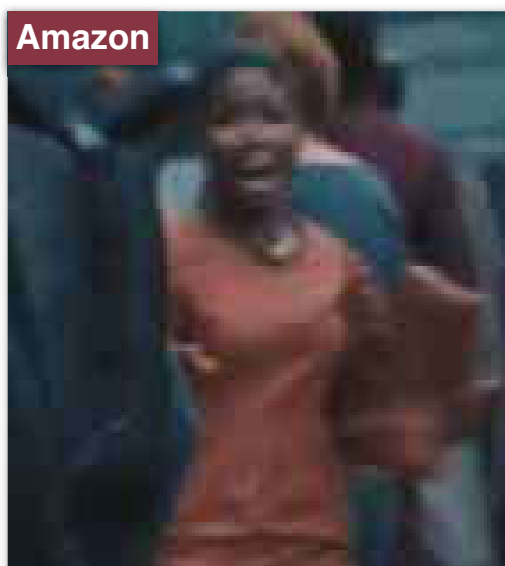
While Blu-ray may lag behind for now, an Ultra HD version of the format is due out at Christmas. This will support HEVC decoding and higher-capacity discs, with films encoded at a higher bit rate than for streaming. In other words, 4K Blu-ray will have better image quality once again.

HEVC AND FULL HD

One of the benefits of HEVC is that it can be used to encode HD video. While it still requires new kit to decode it, there are two possible advantages. First, HD video can be streamed using less bandwidth; second, the same amount of bandwidth could be used as now, but the quality of the picture could improve to Blu-ray levels.

VERDICT

Blu-ray is the superior format for HD video at the moment, although streaming could catch up. When it comes to the future, if you want the best-quality Ultra HD films, the new Blu-ray format will be the best way to get it. **CS**



This lady's facial features are far less defined on the streamed video, but you have to zoom in close to notice

SUBSCRIBE NOW!



Subscribe to **COMPUTER SHOPPER** today and save on the single issue price.

Each issue of *Computer Shopper* will be delivered directly to your device each month.

SEE NEXT PAGE FOR SET-UP INSTRUCTIONS

▶ HOW TO SUBSCRIBE...

...on an iPad or iPhone

- STEP 1** Return to the *Computer Shopper* library
- STEP 2** Choose your subscription term and tap twice on the 'price' box
- STEP 3** Choose whether to create an optional [PixelMags](#) account
- STEP 4** Enter your [Apple ID password](#) to confirm



...on a Kindle Fire

Kindle Fire subscriptions come with a **FREE** one month trial.

- STEP 1** Tap '[Free Trial Subscription](#)' in the *Computer Shopper* library
- STEP 2** Choose your subscription term from the drop down menu on the popup that appears
- STEP 3** Tap '[Subscribe](#)'



...on an Android device

- STEP 1** Open the Google Play Store [homepage](#) and navigate to the [Newsstand](#) section using the tabs at the top
- STEP 2** Search for *Computer Shopper* using the search icon in the top right of the screen
- STEP 3** Click the '[Subscribe](#)' button and pick your term
- STEP 4** Enter your [Google password](#) to confirm



...via the Zinio app

- STEP 1** Search for *Computer Shopper* via the search box in the [Shop tab](#)
- STEP 2** Tap the '[Subscribe](#)' button
- STEP 3** Choose whether to create an optional [Zinio](#) account
- STEP 4** Enter your [Apple ID password](#) to confirm



**Subscribe to *Computer Shopper* today
and save on the single issue price**

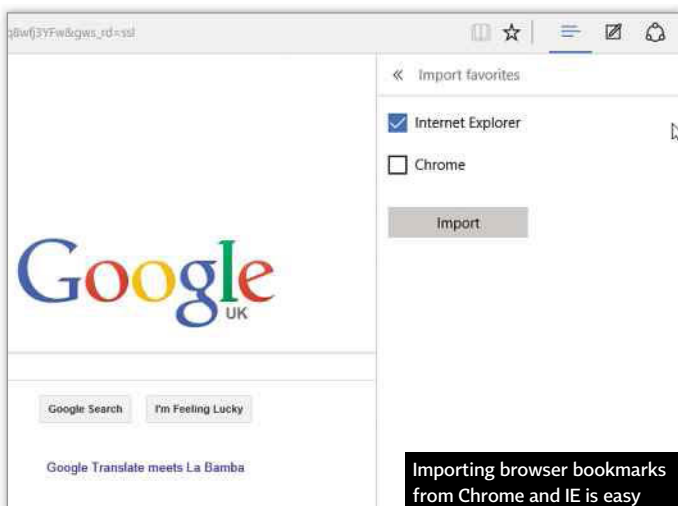
How to... Import bookmarks into Edge

If you'll be using the Edge browser in Windows 10, you'll first want to import your bookmarks from your old browser. Here we show you how to do just that

MICROSOFT'S NEW EDGE browser comes as part of Windows 10 and is neatly integrated with the new operating system in terms of appearance and support for Microsoft's various cloud-based services. Once you've installed it, you'll want to transfer all your bookmarks from your old browser to Edge. Fortunately, it's very easy to do this, as we'll explain here.

IMPORTING CHROME AND INTERNET EXPLORER BOOKMARKS INTO EDGE

Microsoft has made it very easy to import your favourites into Edge. In the browser, click on the Hub button (the three horizontal lines) and then select the Import favorites button. Here you'll be able to import both Chrome and Internet Explorer bookmarks (including their original folder locations) into Edge. Simply tick the browser whose bookmarks you want to import, and a fraction of a second later you're done. These favourites will now appear under the Favourites section (star icon) of the Hub menu.



IMPORTING FIREFOX BOOKMARKS INTO EDGE

You may have problems importing from Mozilla Firefox; none of our Windows 10 PCs running Edge were able to find Firefox's bookmarks to import. No fear, though: there is a workaround that doesn't require any extra software, just a couple of extra steps.

Open Firefox and press Ctrl-Shift-B to open the bookmarks manager, click Import and Backup and select Export bookmarks to HTML. Navigate to somewhere easy to find (such as the desktop or your documents folder) and click Save. This will put all your bookmarks into an HTML file in the specified location.

The next job is to import this file to your new browser, but you have to do it through an intermediary, so open Internet Explorer. Click on the

As an aside, it's worth mentioning the new browser's performance. We've done some testing on Edge and the results aren't exactly stellar. However, there's a lot more to browsers these days than rendering speed, and unless you visit a lot of animation-heavy sites you shouldn't have any problems. For more on Windows 10, see our feature on page 96.



favourites button (the star) towards the top-right of the window and click the down arrow next to Add to favourites, and click Import and export. Select Import from a file and press Next. Put a tick in the Favorites tickbox then click Browse and navigate to the place where you exported your Firefox bookmarks. Choose a location for your bookmarks (try at the top of the file tree so you don't end up importing oodles of folders and subfolders into Edge) and select Import.

Now follow the steps for importing into Edge from Internet Explorer (above), and you'll have all your bookmarks in no time.

These steps also apply to other more niche browsers that Edge doesn't support. You'll need to export your bookmarks in that browser and re-import them into IE before putting them into Edge. ☞



☞ You can use Internet Explorer as an intermediary to import your Firefox bookmarks

Edge is neatly integrated with Windows 10 in terms of appearance and support for Microsoft's various cloud-based services

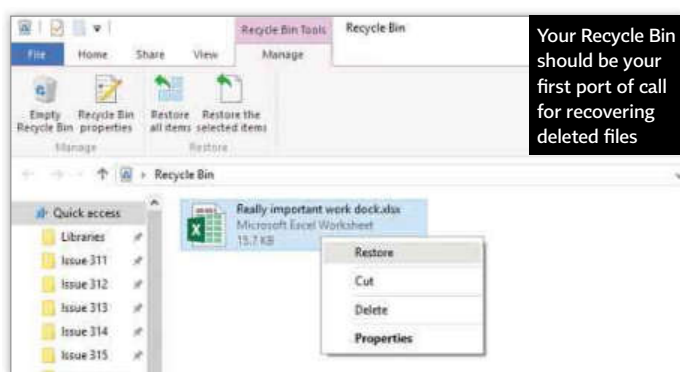
How to...

Recover deleted files

If you've lost or accidentally deleted an important file, don't panic – it should be possible to get it back if you follow our guide

LOSING AN IMPORTANT file can be a nightmare, but if this happens to you, there's a good chance you'll be able to get it back. Here we'll show you a variety of ways to restore your deleted files, but first we'll explain how file storage actually works.

Files are stored on a hard disk or flash drive, with a file table telling the operating system where the actual file is located. When you delete something, its entry is merely removed from the file table and allocated as free space, but the file is still there on your hard disk.



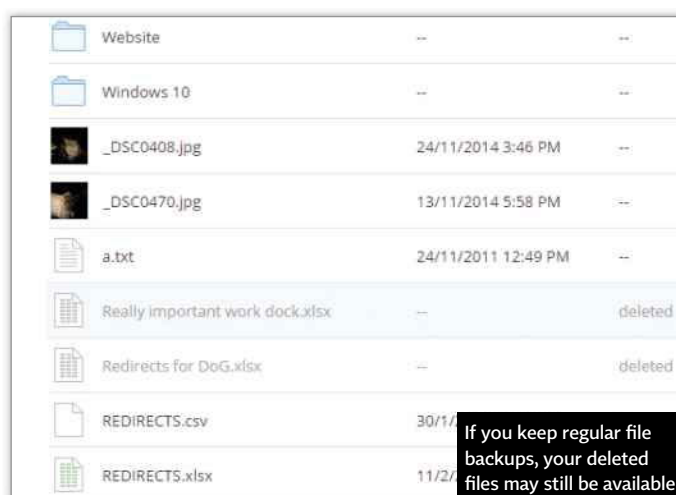
METHOD 1 Check the Recycle Bin

This may sound a bit obvious, but check your computer's Recycle Bin to see if the file is in there. Everything you've deleted from internal storage should go automatically to the Recycle Bin; only exceptionally large files don't. There are a couple of other exceptions, too. First, if you used the key combination Shift-Delete, the file is permanently deleted. Second, removable storage devices such as flash drives and external hard drives are a bit random in that some support the Recycle Bin and some don't. In other words, you can't rely on the Recycle Bin.

This means that with the right tools you can recover the file. However, the danger is that while you're looking for ways to get your data back, it will already have been overwritten by new files.

For that reason, we recommend that you download any tools to a different drive. You should also shut down any unnecessary applications, so that they're not creating additional files.

Note that these instructions apply only to local storage on internal and external hard drives, not network drives.



METHOD 2 Go to a backup

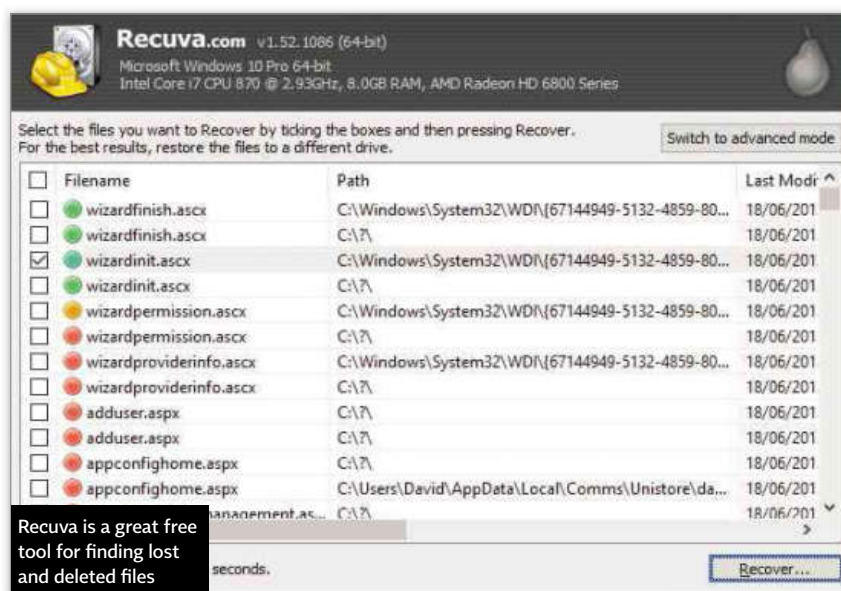
If you're running backup software, your deleted file may be there. Dropbox, for example, keeps deleted files for 30 days. If you're using more a traditional file backup system, a version of your files should be available in the latest backup, even if it's not the most recent one.

File-recovery software scans your hard disk for files that have been removed from the file table

METHOD 3: Use file-recovery software

If you can't find your files using the methods above, you'll need to use file-recovery software. This scans your hard disk looking for files that exist, but have been removed from the file table. Recuva (www.piriform.com/recuva) is our tool of choice, as you can download it to a USB flash drive and run it from there. When you run the software you can tell it the types of files you want to find (such as pictures, music and so on), and you can choose which drive to search. If the software doesn't find what you want, the Deep Scan option takes longer, but is more thorough.

Once the scan has finished, put a tick next to the files you want to restore, click the Recover button and choose where you want to save the files. **CS**



How to...

Manage boot devices

Getting your computer to boot from a source other than your primary hard disk is easier than you might think. **David Ludlow** explains how to do it step by step

WHEN YOU SWITCH on your computer, it usually boots from your primary hard disk, but that isn't necessarily the first device it wants to use. That's because your computer's BIOS has a boot order setting, which tells it the order in which it should check your computer's various drives and storage devices in search for a bootable disk.

Typically, your computer will be set up in such a way that you can boot it from a source other than your hard disk without having to fiddle with any settings. So, for example, most computers are set up to check the CD/DVD optical drive first, as this enables you to insert an operating system installation disc and boot from that if you need to.

Booting from a USB drive

If you're booting from a USB flash drive, insert the drive before you turn on your computer. If you don't, your PC's BIOS may not recognise the drive and won't let you boot from it. Any USB port will do, but if you're having trouble getting the front ports to recognise your device, try using a port at the rear of your computer, as they tend to provide more power. We've had problems in the past with some USB drives failing to be recognised by a computer's BIOS, so if your drive simply won't show up, you may need to try an alternative drive instead.

The same steps apply if you're trying to boot from a USB hard disk, although you may need to provide external power to some drives before the BIOS will recognise them.

Finally, make sure you plug your USB drive into the appropriate type of port. If you've got a USB3 flash drive, for example, plug it into a USB3 port to get the fastest speeds.

METHOD 1

The boot menu

The easiest way to choose which device to boot from is to use your computer's boot menu. This lets you select a drive from a menu for a one-time boot: it doesn't affect the regular boot order, so next time you restart your computer it will go back to

As many operating systems are now installed from USB drives, the default system isn't always the most appropriate one and you may need to tell your PC to boot from this type of removable drive instead. Alternatively, if you've got more than one hard disk in your PC, you may want to have different operating systems on each, in which case you can use your computer's boot options to choose which to boot from. As you can see, there are plenty of reasons why you'd want to change the boot order, and we'll show you how to deal with each of them here. Bear in mind that each computer's BIOS is slightly different, so check your motherboard's manual for full instructions.



↑ If your computer has a boot menu option, it's easy to change which device you boot from

using its regular hard disk. This option is useful if you're installing an operating system, as you can select your flash drive, install Windows and then just boot from your regular hard disk.

To get this option, you need to reset, reboot or start your computer from fresh. Look out for the Power On Self Test (POST) screen, which is the information screen you first see when you turn on your computer. It's possible that this is hidden by a logo, so look out for a message telling you to hit the Tab key. Next, look out for a message telling you which key to press to get the boot menu: F9, F10 or F12 are all common keys, but check your computer's manual to see if there's a different key to press.

Once you've hit the key you may have to wait while the computer goes through its normal tests, but eventually a boot menu will pop up. Just use your cursor keys to select which device you want to boot from. Hit Enter, and your computer will start from the device you've chosen.

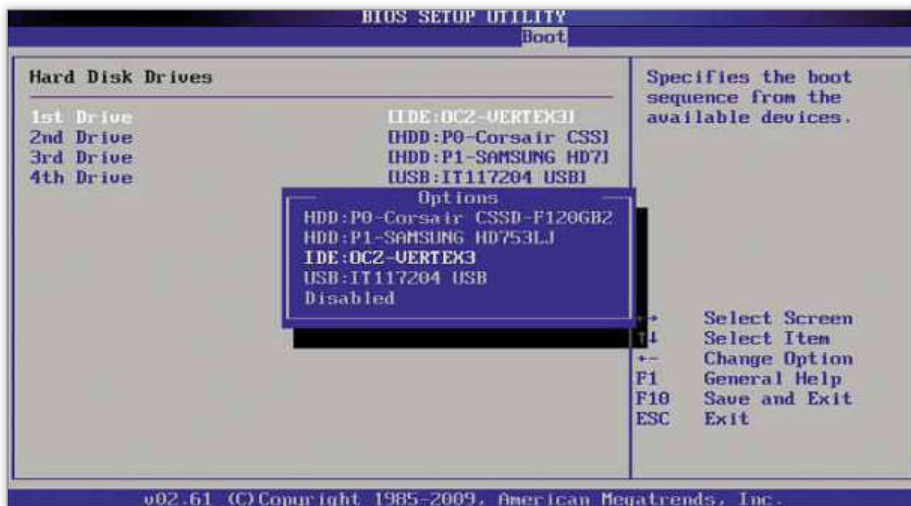
METHOD 2

Inside the BIOS

If your computer doesn't have a boot menu option, you'll need to change the boot order by going into the BIOS (or UEFI on newer computers). This is also the best



↑ The boot priority menu lets you choose which devices your computer will try to boot from first



↑ If you can't see your storage device in the boot priority menu, you may have to set it as the primary disk



↑ Once you've changed your hard disk order, the boot priority menu will change too

option if you want to make a permanent change, such as if you've added an SSD to your system and want to boot from that instead of your mechanical hard disk. The exact instructions will differ from manufacturer to manufacturer, so you may need to consult your computer or motherboard's manual. Each BIOS will detect drives in a different way, so don't worry if your boot device doesn't show up where you expect it to, as it may just be listed under a different screen. We'll show you how to deal with all eventualities.

Look for the Boot menu. This will show you the order in which your computer looks for a bootable device. Starting at the top, the first device on the list has priority over the next one down, and so on until you get to the bottom of the list. To change an entry, select it using cursor keys or your mouse and choose your preferred boot device from the menu that appears. Repeat these steps until the devices are listed in your preferred order of priority. It's possible that your computer will have a generic Removable Devices option that sets it to boot from USB devices first. We've often found this type of option to be unreliable as the PC often fails to detect our USB drives. Instead, if you want to boot from USB, select the specific drive you want to boot from.

Some BIOSes list every single drive that's connected to your computer, but not all of them do. In fact, you may notice that a USB flash drive fails to appear as an option, and that your computer's second hard disk (if it has one) isn't

Your computer's BIOS has a boot order setting, which tells it the order in which it should check your computer's various storage devices

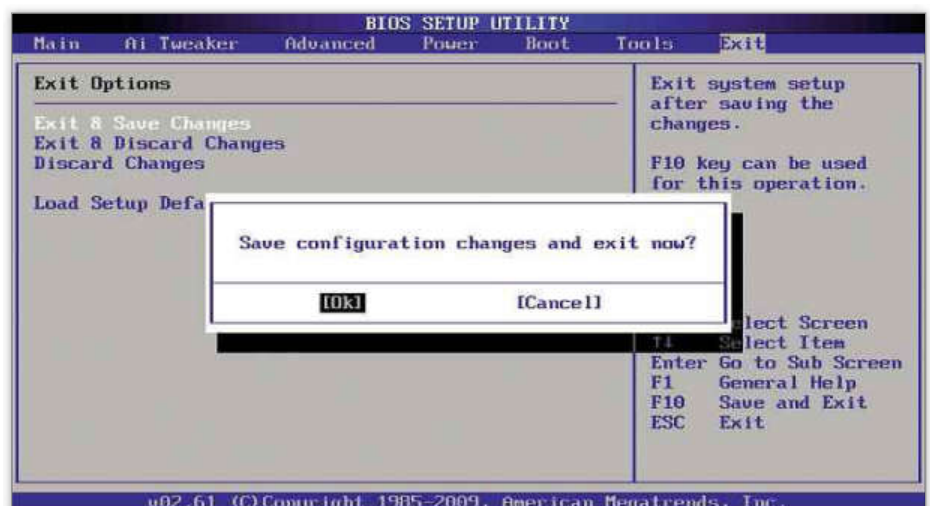
listed either. If so, don't panic, as the most likely explanation is that your BIOS has a separate menu for the hard disk boot order. This will probably be a sub-menu from the main Boot menu. Go into this hard disk menu and, using the same process you'd use to change the boot order, change the top entry to the USB drive or hard disk you want to boot from. Make sure the second hard disk and any others are also set up in the correct order.

Go back to the original boot menu and you'll see that your computer now lists your chosen hard disk or flash drive as a boot option. Save your settings and your computer will restart. It will then boot using the priority order you've set. This order will stay the same until you change it again by following these steps. Note that if you remove the USB drive from your computer, the boot priority list will change, shifting everything else up a step. For most computers this will mean the PC starts from the hard disk with the highest boot priority.

Still can't boot from USB?

If you've chosen to boot from a USB flash drive to install an operating system but your PC isn't loading the installer, the solution is probably very simple. After switching on your PC, look out

for a 'Press any key to boot from USB' message. Unless you hit a key at that point, your PC will skip the USB drive and move on to the next boot device you've configured. You don't have long to hit a key, so look out for this message. This system is designed to stop your PC loading the installer repeatedly if you leave the installation disk connected, but it can cause confusion. If you don't see a message and your PC still won't boot, make sure the USB flash drive has the correct files on it. Alternatively, try creating the installation media on a different drive. ☐



↑ Save the new settings and your PC will reboot from the drive you selected

Business Help

If you have databases, office applications and macro issues, **Kay Ewbank** can help. Send your problems to businesshelp@computershopper.co.uk



Macros in PowerPoint

Q I'm just getting to grips with PowerPoint, though I'm experienced with Word and Excel. I want to record a macro to give the people using my presentation a way to print the current slide in Show mode, but I can't find the equivalent of the Word macro recorder. I'm sure there was one there the last time I had to use PowerPoint back in the dark ages, but these days we use PowerPoint 2010. Is it an option I can enable like in Outlook?

Alex Moor

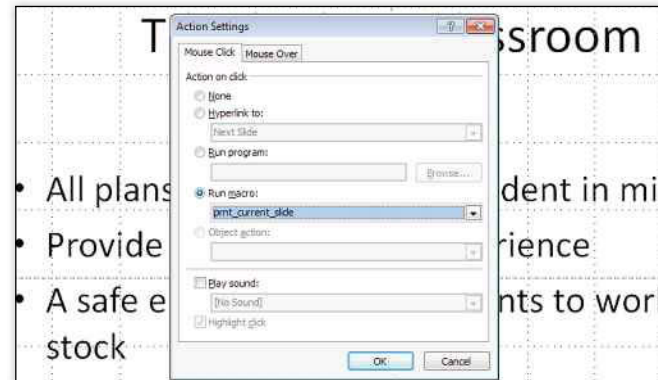
A The macro recorder in PowerPoint was removed a few versions ago, but you can still create macros. What you need to do is to go to the View menu, where you'll find the Macros menu lurking. If you click it, you'll see a dialog that lets you run existing macros, or create new ones. To create a new macro, enter a name for it, then click Create. The Visual Basic macro editor will appear, and you can type the following macro:

```
Sub prnt_current_slide()  
Dim thisslide As Integer  
thisslide = SlideShowWindows(1).View.  
CurrentShowPosition
```

```
With ActivePresentation.  
PrintOptions  
.OutputType =  
ppPrintOutputSlides  
.RangeType = ppPrintSlideRange  
.Ranges.ClearAll  
.Ranges.Add Start:=thisslide,  
End:=thisslide  
End With  
ActivePresentation.PrintOut  
End Sub
```

What the macro does is simply set the variable 'thisslide' to point to the current slide, then set a range for printing that starts and ends with the current slide. The important thing to note is that you can't use this macro with the presentation in Edit mode. If you do, you'll get an error, so you have to attach it to a button on each slide where you want it to be available, and run the macro from the slide by clicking the button.

The way you do this is to click on Shapes in the Illustrations group on the Insert tab of the Office Ribbon. You'll see Action Buttons among the choices. While you could just choose the button shape you like best, it makes more sense to avoid the ones that



◆ Use an Action button to add a macro to a slide in PowerPoint

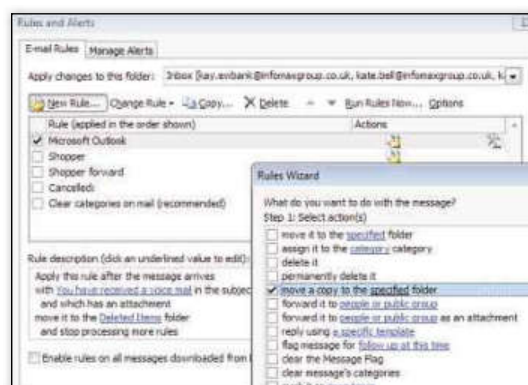
would make the user think of some other task, and to pick the boring 'custom' button. Add it to the slide and, in the Action Settings dialog box that appears, select the Run macro option and choose the name of the macro you just created from the drop-down menu.

You should also give the user a clue as to what the button does, so once back in the main edit window, select the button, then go to the Drawing Tools menu. Click Text Box in the Insert Shapes group of the ribbon. If you select Text Box while you've selected a shape, you can use it to add text to the shape, so you can then type a message such as 'Click to Print' on your button.

Moving Outlook messages after reading

Q I've a problem with setting up Outlook so I can read emails both on my desktop machine at work and on my phone. What I want to be able to do is to read the message in my inbox (on either machine), then have it copied to a folder for archiving. If I set up a rule to copy the email to a folder when it comes in, there's no copy in the inbox so I can't see it on my phone. If I leave it in the inbox, I have to remember to archive it manually otherwise it gets deleted by default when it's two months old because that's our company policy. What I want is a rule that says 'move the message once I've read it' – how can I do that?

John Kirkbride



A Unfortunately Outlook 2010 doesn't have the exact option you want, but you can set up a rule to move a copy to a specified folder when the message

◆ You can set up a rule in Outlook to move copies of emails to a specified folder

arrives. That way you get your local archive copy, and you also keep the 'inbox' one so you can view it on your phone.

Choose Rules from the Home tab of the Outlook ribbon, then choose Manage Rules and Alerts. In this dialog, choose New Rule, and select the option 'Apply rule on messages I receive' in the 'Start from a blank rule' menu. Click Next, then click Next again. Reply Yes to the question telling you the rule will be applied to all messages you receive, and checking that this is what you want to happen. On the next page, you'll see 'Move a copy to the specified folder' as the fifth choice on the screen. Choose this option, and specify the folder you want to use.

Total columns in Access

Q I've inherited an Access database from a colleague who's left. It was developed in Access 2007, but we're now using Access 2010. Some of the tables seem to be more like a report as they have summary information displayed at the end of the records, in a line called Total. The totals seem to be the sums of the numeric values.

I'm not sure how my former colleague coded this, but it seems a useful thing to have; how do you go about it? I can't see anything in the table definitions, and the summary data doesn't appear on the reports in the same way.

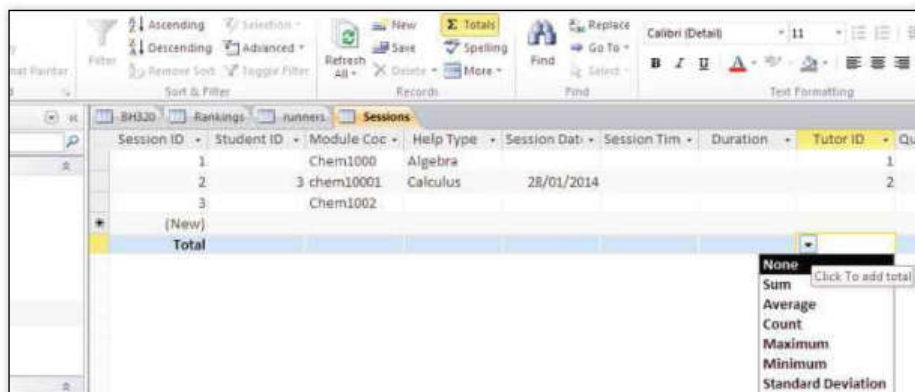
Simon Monte

A What your colleague has done is to use a feature of Access that was added in Access 2007. If you look in the Records section of the Home tab of the Office Ribbon, you'll see a Totals item. If you select it, a Totals line will appear at the end of

the table when viewed in Datasheet view. There are some Access users who started life with a table of data in Excel, and who are reluctantly now using Access, and this feature lets them see the 'standard' totals in Datasheet view rather than having to create a query or report.

If you click on the drop-down arrow next to a cell on the Total line, you'll see a choice of various statistics you can view as the 'total' for the column in the datasheet, so in addition to showing the Sum, you can choose to see the Average, Count, Maximum or Minimum, Standard Deviation or Variance.

We don't tend to use it, and it certainly confuses the issue between what's a table and what's a query or report, but so long as you feel comfortable with it, go ahead. If you decide to keep things simpler, you can remove the Total line by simply deselecting the Totals button in the Records section of the Home tab on the Office Ribbon.



↑ Selecting the Totals button on the Office Ribbon makes the Total line appear in Access data tables, and you have a choice of what total you want to see calculated

Excel doesn't recognise correct dates

Q I've an Excel spreadsheet that contains a set of dates that are in the format dd/mm/yyyy. I want to change them to be yyyy/mm/dd. My problem is that I can't change them to the required format, they stay looking the same, even when I try formatting them as a custom format of yyyy-mm-dd. Nothing works. I've attached the sheet so you can see exactly what I mean. What's going wrong?

Paul Dixon

A The answer lies in the fact that your cells are formatted as text, rather than as dates. There's a clue to this in the fact the 'dates' are left-aligned; real dates would be right-aligned. The simple solution to your problem is to change the format of the column from Text to Date. To do this, select the column, right-click and choose Format Cells, then choose Date from the options, and either enter or select the format you want.

Next, with the column selected, click the Data tab in the Office ribbon, choose Text to Columns, and in the final step choose YMD.

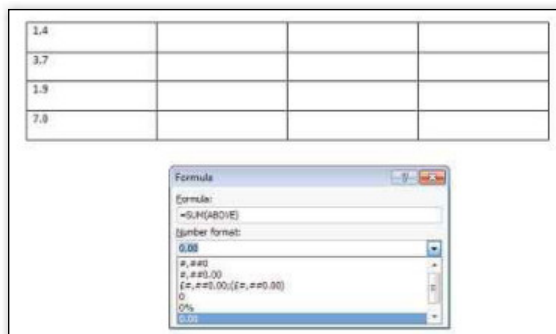
If for some reason this still doesn't work, put the number '1' into an otherwise unused cell, then copy it to the clipboard. When you've done that, select all the cells containing the text dates, and from the Home tab of the Office Ribbon, choose Paste, Paste Special. In the dialog that appears, select Values, Multiply. Click OK, and you'll see the text values converted to date values.

Wrong number of decimal places in Word

Q I've a problem with the way figures are showing in my Microsoft Word document. It has a table of values, and I've used the AutoSum option to get a total for each column in the bottom row of the table. The problem I have is this: if I enter

the values into the table all with the same number of decimal places, the total at the bottom matches that pattern so long as the answer also works out to have the same number of decimal places. So if I enter 5.5, 3.2, 1.9, 4.7, for example, in a column, the answer would (correctly) show as 15.3. If I add another value to that list of 1.7, the total won't show as 17.0, but just as 17. How can I set the format of the table to get the result I want?

Sumir Raschid



↑ Set the field format to 0.0 to show one decimal place in Word tables

A From what you say, you added the totals by choosing Formula from the Data group of the Table, Layout tab of the Office Ribbon. If you click on the Formula option, the function you are offered as standard is the

Sum function. In fact, what is inserted is a Word Field with the formula:

=SUM(ABOVE)

To make the value appear with the same number of decimal places as the other figures in the table, what you need to do is modify the field code you've inserted into the table. Highlight the field in the bottom row of the table, right-click and choose the option to Edit the field. Click on the Formula option, and change the formula so that instead of reading: { =SUM(ABOVE) } it reads:

{ =SUM(ABOVE) \# "0.0" }

The easiest way to do this is to use the Number Format option, and either choose or type the format you want. If you want one decimal place, you need a number format of 0.0. If you want two decimal places, use 0.00. You can play around and see which one looks best. ☑

Helpfile

Whatever your general PC, hardware and software woes, **Simon Handby** is here to help. Send your problems to help@computershopper.co.uk



Windows 10 installation woes

Q I have a Palicomp AMD Kaveri Evolution PC, running Windows 8.1. I have Windows Update set to let me choose when to download and install updates, but for a while now I have had problems doing so. If I try to download the whole list my PC claims to be downloading, but although the progress bar cycles across the screen there's no progress. The download rarely gets beyond 5% before stopping. I have tried downloading individual updates, and using the Windows Update Standalone Installer. However, either method just results in the endless cycling of the 'progress' bar and no downloads. I've turned off various apps that might be conflicting, but the problem persists. I'd like to take advantage of the free upgrade to Windows 10, but I don't think I'll be able to until I can update Windows 8.1 properly. Can you help?

Chris Palin, aykayp@live.co.uk

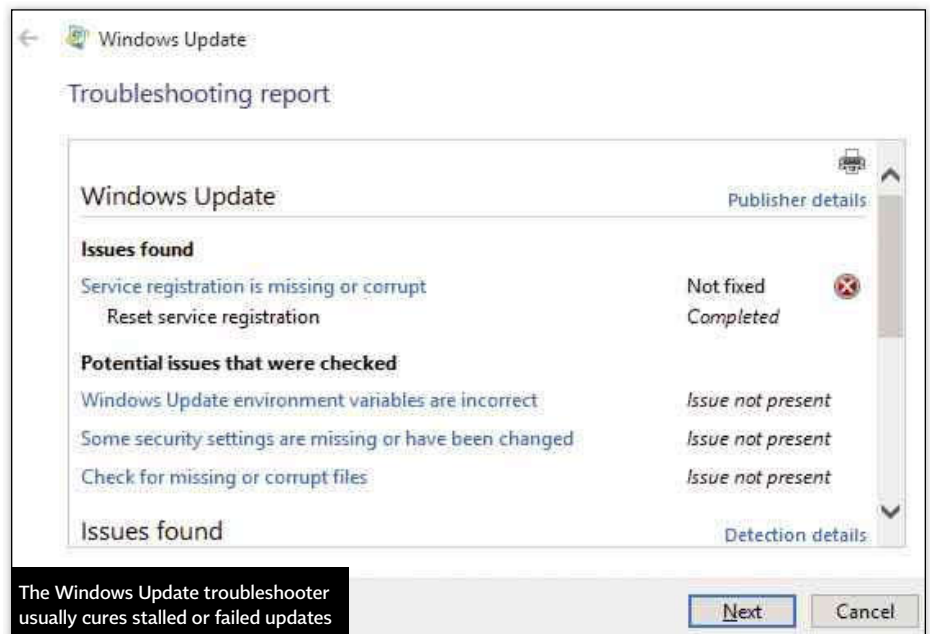
Q I have three Windows 7 computers. Two of them show the Windows 10 logo in the taskbar, and on each I have successfully requested the upgrade. However, my third PC doesn't show the logo, and when I downloaded and ran the Windows 10 compatibility app I got a message to the effect that my version of Windows will not support the upgrade. I'm puzzled, as it's a Windows 7 PC with a valid OEM product licence. Can you help?

Peter Clegg, peterclegg.cha@gmail.com

Q Windows 10: the most eagerly anticipated offering from Microsoft for years, thoroughly beta tested, straightforward to install, and – best of all – free. But when 29th July came around, what happened? Nothing on my Windows 8.1 desktop and laptop, on both of which I had reserved a copy of Windows 10 using the 'Get Windows 10' app.

On 30th July I noticed that both had had Windows Update failures with the error code 80240020. I've found other people on the web with similar problems, and have tried various suggestions without luck. Am I doomed to run Windows 8.1 forever?

Graham Potter, grahamandangie@btinternet.com



A These are three different problems, but they have similar solutions. In all cases it's essential to update a Windows 7 or Windows 8.1 PC before upgrading to Windows 10. From the Start menu or Start screen, search for Windows Update, run the applet and confirm when the most recent check for updates happened. Depending on your settings, you may already have updates waiting for download, but if not, click on Check for updates in the left-hand pane and see if there are any found.

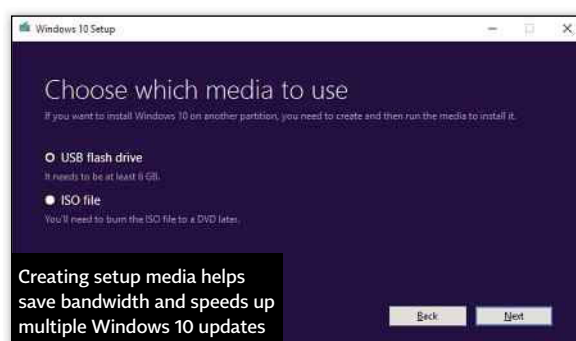
Make sure you install all the available important updates, and then reboot if necessary. In any case where Windows

Update isn't working, download and run Microsoft's troubleshooter from tinyurl.com/333update, then try again.

We've found that the Get Windows 10 app has proved a bit of a red herring, taking its time to download the upgrade for those who requested it, and often not even appearing on Windows 7 PCs. Now that Windows 10 has launched, the easiest way to install it is via the download tools at tinyurl.com/333download. Download the tool that matches the PC you're using (32- or 64-bit); you'll choose the target computer's architecture later.

When you run the tool you'll first need to choose whether to 'Upgrade this PC now' or create installation media.

The first option is more straightforward, but where there are multiple PCs to upgrade we recommend the second option, as this will minimise the size of the necessary downloads. Once you've created a USB flash drive for the upgrade, you'll need to boot from it in the target system(s). You may need to enter the BIOS to change the boot device priority first; you'll find instructions in the user manual.



Heuristic scans broke my software

Q After a recent upgrade to Norton Internet Security, a full system scan now uses a heuristic search to look for viruses. This resulted in some files being quarantined, and others within compressed folders being queried; the software asked if I also wanted to quarantine these. After the scan, my TomTom Home software failed to load, Internet Explorer brought up an error, and some other programs encountered problems.

As I understand it, heuristic viruses are only potential threats, so was my system at risk or not? To get everything working again I've had to do a System Restore, which has, of course, put back the potentially dangerous files. I'm reluctant to do a full scan again. What should I do regarding files that are queried after a heuristic scan? Should I disable heuristic searches?

Keith Jones, kaj8023@btinternet.com

A Your understanding is correct: in virus scans, a heuristic search looks for patterns of code or behaviour that are similar to known malware or its exploits. The idea is that this may detect new malware if it works in a recognisable way, but it's also unavoidably approximate: it can generate a lot of false positives.

It sounds like this probably happened in your original scan, although it's not beyond the bounds of possibility that you have a new, as-yet



uncharted virus on your system which the heuristic scan has picked up. While we'd say this is extremely unlikely, we can't be certain.

Usually we'd be happy to disable heuristic searches unless we felt a system was particularly at risk; if, for example, its owner frequently downloaded 'cracked' software from dodgy websites. The feature can be switched off in Norton Security 2015: click the settings gear wheel near the top right (not the Advanced one on the Security tab). Click Antivirus, click Scans and Risks, then move the Heuristic Protection slider to the Off position and apply the change.

Guest the password

Q I have a Linksys LAPAC1200 access point, connected to a Fritz!Box 3390 modem/router. I've set up a guest network on the Linksys, using the Basic Wireless Settings page to create a second SSID and password. This means I don't have to give out my main Wi-Fi password to guests, but they can see everything on my home network; I would like to allow them internet access only.

I can see an option in the Wi-Fi settings to choose a different virtual LAN (VLAN) for each SSID. Presumably my router would have to know about these different VLANs in order to allow full network access for users of the main wireless network, but limit guest Wi-Fi users to the internet. When I select the Linksys access point in the list of devices displayed by the Fritz!Box, there aren't any settings that would help. Is it possible to tell me how to proceed, in simple terms?

Mark Adams, mark@hermann-adams.com

A A simple way to lock guests down would be to return to the access point's Basic Wireless Settings page and tick the Isolation box for the guest SSID. This should prevent guests on that SSID from seeing other devices on either the guest or home wireless networks, but they should still have internet access.

Where it gets complicated is if you also have wired Ethernet devices plugged into the Fritz!Box router's LAN ports, as guests will still be able to access those. If that's the case, the best option would be to create a guest wireless network on the Fritz!Box and keep the Linksys wireless network for your own use. To do this, re-enable the wireless network on the Fritz!Box if necessary: in a browser, go to <http://fritz.box>. Change the setting in the Radio Network submenu under WLAN. Now visit the Guest Access submenu and set up a guest SSID and password. Finally, log in to the Linksys and disable the guest network you created there.

This should work, but it's not ideal as you have two wireless networks, potentially competing with each other. Ideally the access points' auto-channel features would prevent a clash, but in our experience this doesn't always work well. If you have problems, try manually setting the channel on each so that they don't clash: use only 1, 6 or 11, as the other channels overlap somewhat. For the Linksys, the feature is found on the Basic settings screen in the Wireless menu. You'll need to switch to the advanced view in the Fritz!Box menu, then there should be an option on the Radio Channel submenu under WLAN.

Pat cash accepted

Q I maintain a small website for the local tennis club, which mostly lists information members might need. At the moment the annual fees are collected by members filling in a paper form and mailing it off with a cheque to the club treasurer.

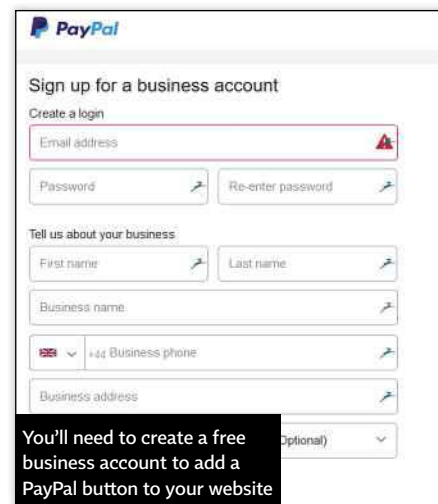
It would be nice if members could pay the annual subscription via the website, but I have no idea how to go about setting such a system up. I have a basic understanding of HTML and cascading style sheets (CSS). I can see that setting up a suitable form wouldn't be a problem, but I have no idea what to do or where to start with taking payment. Can you point me in the right direction?

Steve Webb, steve@webbsfamily.co.uk

A The easiest method would probably be to accept PayPal, which lets you take payments from members with a PayPal account, but also handles card payments from people who don't. There is a small fee for every transaction, the rate of which depends on the club's monthly PayPal income; we're guessing you'd be in the lowest bracket, which means charges of 3.4% plus 20p for each transaction.

It's easy to set payments up. Assuming the club has its own bank account, you need to create a PayPal business account via tinyurl.com/333paypal and link it to the club bank account or debit card. Once you've done this you can get a 'Pay now' button that you can customise, then simply copy and paste its code into the relevant page of the club website.

One alternative that would avoid additional fees would be to switch to an online renewal form, but still allow members to pay by cheque or electronic transfer. Asking subscribers to quote their membership number would help you allocate payments to the correct person. ☑



Build a fan controller for your PC

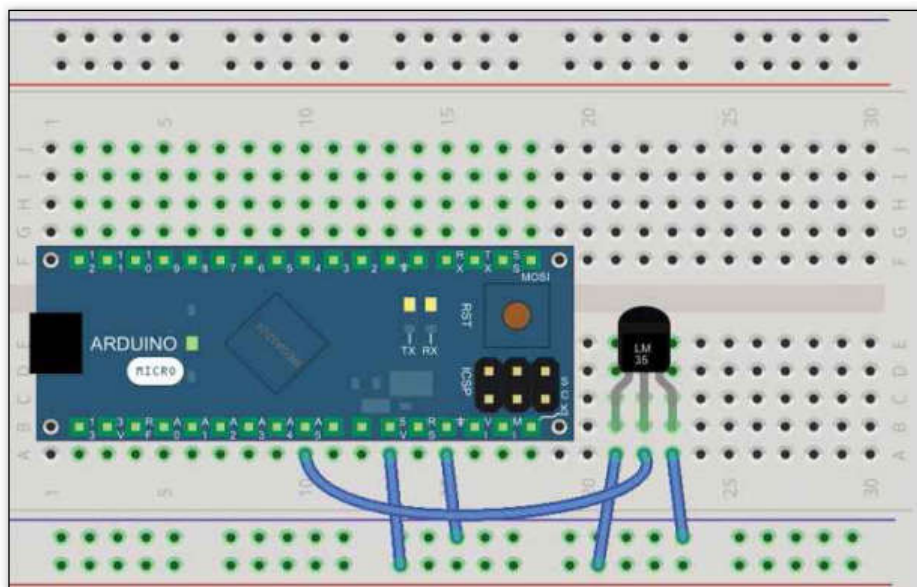
Keep your PC as cool and as quiet as you want with a customisable Arduino-based fan controller. **Clive Webster** shows you how to build it



ALTHOUGH A COOL-RUNNING PC will help extend its life, the inevitable downside is that cooling requires fans, which means noise. It doesn't have to be this way, as we'll show you this month. With our instructions, you'll be able to make an intelligent fan control system, which will keep noise down when your PC is cool, and speed up the fans when it's hot.

Everything we're doing uses the Arduino electronics platform, so the first thing to do is check out the shopping list of components below. We've used common, cheap and easy-to-use components throughout this build. Where possible we've used the same supplier to reduce delivery costs. We've also assumed that you already have some case fans. If you wish to buy new fans there's no need to choose 4-pin PWM models, but remember that more expensive fans have quieter motors and more precisely engineered fan blades to reduce noise.

At the heart of a DIY fan controller are a temperature sensor and a controller chip: we'll use an LM35 sensor and an Arduino Micro, both of which are easy to work with, cheap and reliable. It's best to use a breadboard to mock up your final design, using our diagrams as a reference (generated using Fritzing from fritzing.org). The LM35 has three legs: if you hold the sensor with the flat face toward you, the left leg connects to positive (the Arduino's



↑ We tested each element of our fan controller as we built up its functions; start with the temperature sensor

+5V), the middle is the output (we've used A5) and the right leg connects to Ground (the three diminishing horizontal lines).

ALL UNDER CONTROL

To test the temperature sensor works, download the Arduino control software (called the Arduino IDE) from www.arduino.cc/

en/Main/Software. Run the Arduino IDE, write the simple sketch (opposite, top left) and then tell the Arduino IDE which Arduino board you're using via the Tools, Board menu. To load the sketch on to the Arduino Micro, connect it to your PC via a Micro USB cable, hold down the Micro's reset button, click Compile on the Arduino IDE and only release

PRICES

Component	Price (inc VAT)	Quantity	Total price (inc VAT)	Code	Supplier
Arduino Micro	£19.67	1	£19.67	2285194	uk.farnell.com
Adafruit Heat-shrink Kit	£5.00	1	£5.00	1649	makersify.com
Copper PCB	£4.21	1	£4.21	1172154	uk.farnell.com
USB to Micro USB cable	£3.61	1	£3.61	2444222	uk.farnell.com
Header to USB socket cable	£1.90	1	£1.90	CAB1879	www.cclonline.com
LM35 temperature sensor	£1.48	1	£1.48	1469236	uk.farnell.com
6V sounder	£1.39	1	£1.39	2098836	uk.farnell.com
3-pin fan header	£0.34	1 per fan	£0.67	1654608	uk.farnell.com
100uF/16V capacitor	£0.18	1 per fan	£0.37	8812411	uk.farnell.com
BD139 amplifying transistor	£0.15	1 per fan	£0.30	1084507	uk.farnell.com
1N4007 diode	£0.05	1 per fan	£0.10	9565051	uk.farnell.com
10 KOhm resistors	£0.03	1	£0.03	9342400	uk.farnell.com
12V case fans	N/A	2	£0.00	N/A	Your case
TOTAL PRICE			£38.70		


```

temp_sketch | Arduino 1.6.5
File Edit Sketch Tools Help

temp_sketch $

int tempIn=A5;
int tempMax=23;

void setup() {
  Serial.begin(9600); //Initializes the Serial readout (at 9600 Baud)
  Serial.println("Starting");
  pinMode(tempIn, INPUT);
}

void loop() {
  int rawTemp=analogRead(tempIn); //Update temperature reading
  float temp=rawTemp*0.43828125; //Converts analogue input to Celsius (*0.27226563
  Serial.print("Temperature is ");
  Serial.print(temp);
  Serial.println("C");
  delay(1000); //Set the temperature polling interval, 1,000ms=1s
  // If temp is higher than TempMax (PC is overheating)
  if(temp >= tempMax) {
    Serial.println("ALARM!!");
    delay(5000); //Set how long the alarm should sound
  }
}

Done Saving
No errors found. The code has been successfully compiled and uploaded to the Arduino board.
of ASCII characters and numbers (but cannot start with a number).
They should also be less than 64 characters long.
27

```

This simple sketch tells the Arduino which pin to monitor for the temperature sensor's reading, converts this reading into degrees Celsius, and then allows you to see the results via the Serial Monitor

```

alarm_sketch | Arduino 1.6.5
File Edit Sketch Tools Help

alarm_sketch

int tempIn=A5;
int speakerPin=12;
int tempMax=23;
int alarm=440;

void setup() {
  Serial.begin(9600); //Initializes the Serial readout (at 9600 Baud)
  Serial.println("Starting");
  pinMode(tempIn, INPUT);
}

void loop() {
  int rawTemp=analogRead(tempIn); //Update temperature reading
  float temp=rawTemp*0.43828125; //Converts analogue input to Celsius (*0.27226563 for 3.3V input)
  Serial.print("Temperature is ");
  Serial.print(temp);
  Serial.println("C");
  delay(1000); //Set the temperature polling interval, 1,000ms=1s
  // If temp is higher than TempMax (PC is overheating)
  if(temp >= tempMax) {
    tone(speakerPin, alarm);
    Serial.println("ALARM!!");
    delay(5000); //Set how long the alarm should sound
    noTone(speakerPin); //Turns off alarm sound
  }
}

Done Saving
No errors found. The code has been successfully compiled and uploaded to the Arduino board.
30

```

Setting an alarm for an overheating situation: adjust the 'tempMax' variable to a low value to test the code and sounder

the reset button when the Arduino IDE says 'Uploading'. Wait a few seconds and the Micro should detect the temperature in your room. You can see the readings by pressing the Serial Monitor button on the Arduino IDE (you may have to enter the Tools, Port menu first and select the COM port that isn't COM1). To test the sensor, de-static yourself by touching the down-pipe of a radiator and then hold a fingertip to the sensor to see the temperature readout rise.

The next component to add (because it's easy) is the sounder. Connect its positive leg to a non-PWM pin (we used pin 12, see [tinyurl.com/a-micro-pins](#) for the Arduino Micro's pinout diagram) and its Ground pin to the Arduino's Ground pin: done! Getting the thing to buzz is trickier: first declare the desired pitch of the buzz as a variable (we've opted for a shrill High A), then use the 'tone' function to actually get the sounder to make that noise. We also need a 'tempMax' variable, beyond which the alarm will sound, alerting you to a serious overheating problem in your PC. For our example, we've set 'tempMax' to 23°C, which is roughly the temperature of our fingertip, allowing us to trigger the alarm state easily and test the code and sounder.

MOLEX POWER

So far, so easy, but there's a significant problem ahead: case fans operate at 12V at around 0.12A, and the highest an Arduino pin can output is 5V at 0.04A. We can't drive a case fan directly from an Arduino output pin. Instead, we need to use an amplifying transistor which will accept the low-power input from the Arduino output pin, gather 12V from an external source, and send that combination to our fan. That external 12V source is easily found in a PC; the yellow and black wires of a Molex connector are ideal for the job.

We chopped up an old Molex-to-SATA power cable to get a Molex socket with bare wires at the other end. We then used flat-nosed pliers to squish the pins belonging to the red (5V) and second black wires and pulled these connections out of the rear of the Molex connector. Then we stripped the tips of the yellow and black wires so we could attach the Molex socket to our project.

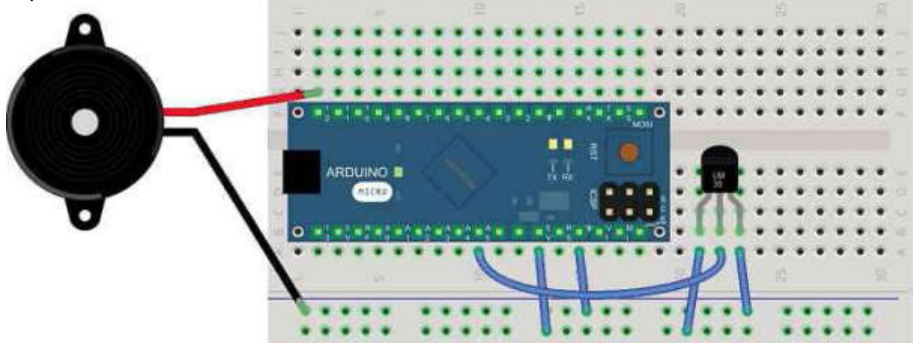
The transistor is a little tricky to wire up, especially as its packaging doesn't correspond to its electronic symbol; you'd think the Base

PWM? What's that?

PWM stands for Pulse-Width Modulation, which is engineer-speak for changing the amount of time each 'on' signal is sent for. To be fair to engineers, 'PWM' is quicker to say. In our case the 'pulse' is a 12V 'on' signal and the width describes how long that signal remains 'high'. 'Modulation' means that the width of these pulses (the pulse-width) changes.

PWM allows a digital system to behave in an analogue way: a digital controller can send a digital signal (either 0V or 12V) but because the duration of that signal varies, the fan spins at 400-1,500rpm. This means a digital controller can achieve analogue results such as making the PC cooler or the fan quieter. Without PWM the fan would either be stopped or run at 1,500rpm; the PC would either be hot or the fan loud; purely digital outcomes.

➔ Connecting the sounder is easy; getting it to buzz requires a bit more effort



pin (the transistor's input) should be the middle, but actually it's the rightmost if you're looking at the non-silvered side of the transistor. Connect the transistor's Base to one of the Arduino's PWM pins – we used pin 5 – to ensure it acts as a PWM controller (see 'PWM? What's that?' above).

To complete the circuit, the Ground of both the Molex (the black wire) and the transistor's emitter need to connect to the Ground of the Arduino. We powered the Arduino from a spare internal USB header on our motherboard (via the two USB cables on the list opposite) to retain the Serial output, but you can power an Arduino from the 12V Molex supply by connecting the 12V yellow

```

temp_test
int tempMax=80;
int alarm=440;

void setup() {
  Serial.begin(9600); //Initialises the Serial readout (at 9600 Baud)
  Serial.println("Starting");
  pinMode(tempPin, INPUT);
  pinMode(rearFan, OUTPUT);
  pinMode(frontFan, OUTPUT);
}

void loop () {
  int rawTemp=analogRead(tempPin); //Update temperature reading
  float temp=rawTemp*0.43828125; //Converts analogue input to Celsius (*0.27226563 for 3.3V input)
  Serial.print("Temperature is ");
  Serial.print(temp);
  Serial.println("C");
  delay(1000); //Set the temperature polling interval, 1,000ms=1s
  // If temp is lower than TempMin (PC is on but cold)
  if(temp<tempMin) {
    digitalWrite(frontFan, LOW);
    digitalWrite(rearFan, LOW);
    Serial.println("Fans off");
  }
  // If temp between tempMin and TempMax (normal)
  if((temp>=tempMin)&&(temp<=tempMax)) {
    rearFanSpeed=map(temp, tempMin, tempMax, 45, 255); //Fan whines if third value too low
    analogWrite(rearFan, rearFanSpeed);
    frontFanSpeed=rearFanSpeed*0.75; //Front fan operates at 3/4s rear fan speed
    analogWrite(frontFan, frontFanSpeed);
    Serial.print("Cooling at ");
    Serial.print(rearFanSpeed);
    Serial.print(" rear, ");
    Serial.print(frontFanSpeed);
    Serial.println(" front");
  }
  // If temp is higher than TempMax (PC is overheating)
  if(temp >= tempMax) {
    digitalWrite(rearFan, HIGH);
    digitalWrite(frontFan, HIGH);
    tone(speakerPin, alarm);
    Serial.println("ALARM!!");
    delay(5000); //Set how long the alarm should sound
    noTone(speakerPin); //Turns off alarm sound
  }
}

```

The final sketch is quite long, but we've marked up the different sections for easy navigation

Done compiling

Global variables use 315 bytes (15% of dynamic memory, leaving 1,733 bytes for local variables. Maximum is 2,048 bytes.

Arduino Uno on COM1

wire from the Molex to the Vin pin of the Arduino. Don't use the Micro USB port of the Arduino if you're powering it from the Molex. Powering the Arduino from a dumb power source might be useful if you want a cooling system for your A/V rack, for example. Use a 12V, 2-4A wall plug with a barrel connector and mate that with a female barrel socket soldered to your project.

The final sketch to upload to the Arduino is quite long (you can download our script from tinyurl.com/fan-control-sketch) and contains a few odd functions. For example, we declare the variable 'int fanSpeed,' without giving it a value. This is necessary to prevent an error when the sketch compiler hits the line 'Serial.println(fanSpeed);'. The amplifying transistors require no specific code. Our thanks go to P Marian of Electro Schematics from whose project we've borrowed (see tinyurl.com/arduino-fan). In particular, his use of the map function for a fan controller project is excellent.

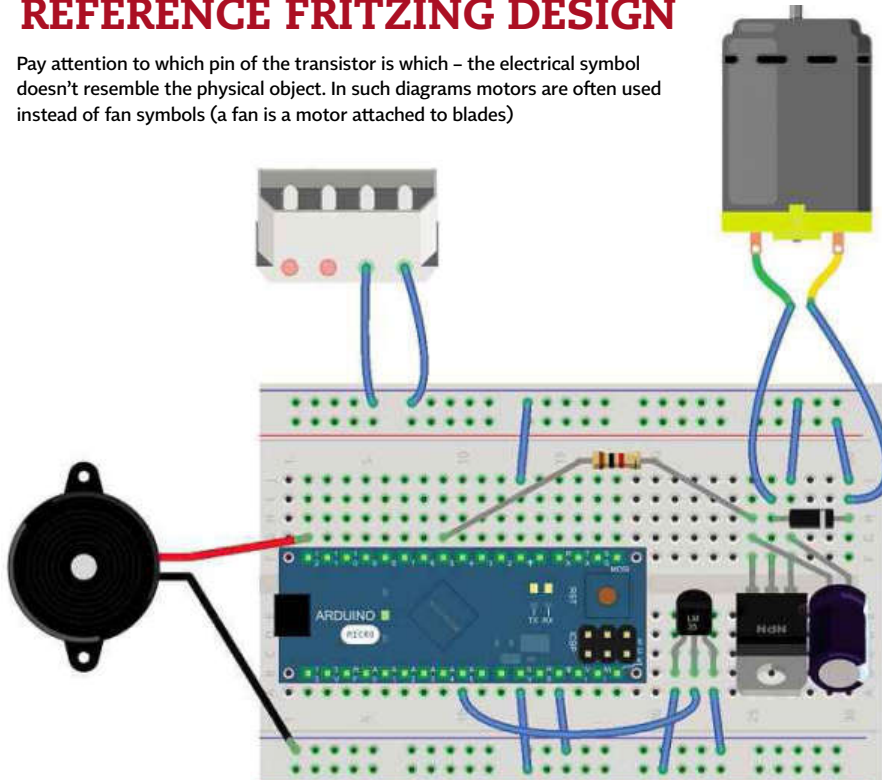
The map function plots the position of the measured temperature ('temp') relative to a range ('tempMin' to 'tempMax'); the resultant PWM value governs the speed of the fan. As the PWM output of the Arduino has 8-bit resolution there are 256 possible outputs (0 to 255), so 'tempMax' produces 100% fan speed at 255. However, we found a PWM value of less than 45 made our fan whine, so we mapped 'tempMin' to a PWM value of 45. With our example variables a measured temperature of 40°C produces a PWM value of 115 (roughly 50% fan speed), while a measured temperature of 60°C gives a PWM value of 185 (roughly 75% fan speed).

To add another fan, you need to attach another amplifying transistor unit to another PWM pin (we've used pin 6). You can either have your fans spin at the same speed, or add additional cooling rules to each section. For example, rear fans are more effective in a PC case and less audible (because they're at the rear), so you might want to spin that fan more aggressively than a front fan. Also remember to use heat-shrink to isolate pins and keep wires safe and tidy.

Once you've verified your circuit works, your sketch is fine and your fans behave as expected (we found LED fans gave a distracting strobe effect at low speeds so are best avoided), you can start cutting up your copper PCB board and soldering the components into place. Hook up your fans, check that your tempMin and tempMax are sensible (monitor the temperature via Serial Monitor) and whack on the heating in the safe knowledge that your PC is as cool as it needs to be while being as quiet as it can. **ES**

REFERENCE FRITZING DESIGN

Pay attention to which pin of the transistor is which – the electrical symbol doesn't resemble the physical object. In such diagrams motors are often used instead of fan symbols (a fan is a motor attached to blades)



NEXT MONTH

MAKE YOUR OWN (FREE) MUSIC-STREAMING SERVICE

Stream your own music from your home to wherever you are in the world

Making your photos stand out

You don't need fancy equipment to take photos that are worth hanging on the wall. **Ben Pitt** reveals 18 tricks the pros use to get that perfect shot



THANKS TO SMARTPHONES, more people are taking more photos than ever before. Once there would be just one self-appointed photographer in each family, but now everyone is snapping away, documenting their lives and sharing photos on social media. Making your photos stand out from the constant stream of snaps, petitions and pet videos isn't easy, though.

There's no single thing that separates casual snaps from the work of a photography enthusiast. It certainly isn't their choice of equipment. There are lots of small measures you can take to improve your photos, though. The 18 tips listed here are all easy to do but can have a huge impact. They include technical advice, artistic techniques and practical tips to bring out the best in your subjects. Whatever your experience and ambitions, we hope you'll find something useful.



BENEFICIAL BLUR

Bracing yourself against something can help prevent camera shake, but you'll still

get blur from moving subjects. That's not necessarily a bad thing, though. While blur from camera shake tends to look like a mistake, subject motion blur can look great, giving a sense of movement to the scene.

The amount of blur depends on the shutter speed, but not all cameras allow you to set this manually. Virtually all include a manual ISO speed control, though, and you can use this to influence the shutter speed. Set the ISO speed to its lowest value (usually 100) to access the slowest shutter speed for a given scene. This can work well in very low light such as bars or night cityscapes, where



Yes, we said it's best to get down to eye level, but this photo proves that some rules are there to be broken

shutter speeds of a few seconds will turn moving subjects into ghost-like streaks of colour. It's an easy shortcut for injecting a bit of artistic flair into photos. You'll definitely need to brace yourself against something solid, prop the camera somewhere or – ideally – use a tripod.



FOCUS ON THE EYES

Focus isn't much of an issue for smartphones and basic compact cameras, as usually

the whole scene will be in focus. However, zooming in with a big telephoto lens or using a camera with a big sensor or wide-aperture lens will result in more selective focus.

Face detection ensures that the camera's autofocus and exposure settings are optimised on people's faces, and a few cameras go further and focus on the eyes. This is great when shooting with a camera with highly selective focus, or narrow depth of field to give its technical name. Having pin-sharp eyes while the hair and shoulders are slightly out of focus gives

portraits a dreamy, romantic quality. If your camera doesn't do it automatically, set the focus point manually so the eyes are sharp.

It's also worth positioning the camera at eye level with your subject. Photographs of children and pets are much more engaging when you're at their level.

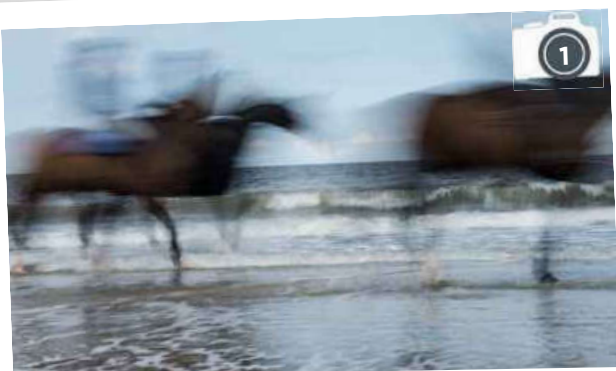


BE ALERT AND QUICK

To take great photos you've got to be ready to seize the moment. Keep your camera

handy so you're able to whip it out in a couple of seconds. Spend five seconds rummaging through your bag and your subject might be doing something else. Add another 10 seconds adjusting the camera's settings and they'll probably have wandered off.

There are some situations where you can afford to take your time thinking about lighting, composition, camera settings and so on – perhaps when capturing a landscape or if you want to photograph people at a fixed location. Don't keep people waiting while you tinker with settings, though. They'll quickly get bored, and that's not a great look for your photo. Trust your camera's automatic settings and capture the moment before it passes.



Slowing the shutter speed down to half a second gives a dreamy blur to these waves and passing horses. We had to use a tripod here to keep the horizon sharp

**BE TRIGGER-HAPPY**

The more photos you take, the better your chances of capturing some real winners.

Taking two or three shots of each subject will act as an insurance policy against camera shake, blinks and weird expressions. Switching your camera to continuous mode is a great way to achieve this without keeping people waiting. Some cameras shoot at speeds up to 10fps, which may be too fast as each shot is virtually identical to the next. However, these cameras tend to have slower options, too. Speeds of around 3fps work well for capturing a short burst. Alternatively, take the first picture quickly to capture the moment, and then take a couple of seconds to think about the composition and lighting (more of which later) for your subsequent shots.

Most importantly, just take loads of photos. It's often surprising which ones work and which don't, so give yourself plenty of choice so you can pick only the very best photographs to share.

**HIGHS AND LOWS**

The biggest limitation for digital cameras is the range of brightness they can

capture in a single shot. Our eyes are far more advanced than any camera, and we can take in a scene with a mixture of direct sunlight and a shaded or indoor area. With a camera, you'll probably have to choose to expose the scene for one or the other. To do this, point the camera only at the area you're interested in, half-press the shutter button to set the exposure level, recompose the scene and then fully press the shutter button.

For smartphones that lack a half-press option, you'll need to use exposure compensation. This is usually labelled EV, and positive values make the scene brighter and vice versa. Exposure compensation is also useful for scenes that are dominated by bright or dark colours. Cameras try to find

the average brightness in a scene and make this mid-grey, but this can make snow scenes, for example, come out a dreary grey colour. Boosting exposure compensation will turn the snow a crisp white and improve skin tones and other colours in the process.

Night scenes and concerts have the opposite problem, as the camera sees lots of black and tries to boost the exposure too much. The result is overexposed subjects over a grainy grey background. Reducing exposure compensation gives much better results, with well-exposed subjects against an inky black backdrop.

**DIFFERENT ASPECTS**

Most compact cameras have a 4:3

aspect ratio, which is the ratio between the picture's width and height. SLRs and most CSCs tend to have a 3:2 ratio, and video cameras are at 16:9. You're not obliged to stick to these, though. Most cameras offer a choice as you capture, and you can always crop photos to a different shape later. Don't forget that people are taller than they are wide, so turning the camera on its side for a portrait-orientation photo often works best for pictures of people unless the background is as important as the main subject.

**ZOOM OR MOVE?**

There are two ways to vary the size of your subjects as they appear in the frame:

use the zoom or use your feet. Zooming is similar to cropping the photo using an image editor – especially for smartphones that don't include an optical zoom. A digital zoom simply crops the photo and enlarges it back to its full resolution, but it can't add any extra detail. Cameras with an optical zoom do capture extra detail, but otherwise the effect is similar to cropping.

You can also make subjects appear bigger by walking towards them, but the effect can be quite different. Imagine taking a photo of someone with a sunset behind them, and their head is about the same size as the sun. Walk towards them and their head gets bigger in the frame, but the sun won't. You may have halved the distance from you to your subject, but the sun is still about 150 million kilometres away. Now imagine walking far away from your subject so they're just a speck



Morning and evening sunlight is great for flattering portraits. Here it's used as a backlight to help our subject stand out from the background

on the horizon. The sun will still appear the same in the frame, and much bigger than your subject. If you had an ultra-zoom camera, you could zoom in and increase the size of both, capturing your subject with a massive sun in the background.

Zooming in makes the background look bigger, while getting closer makes the background look smaller. If you want to give more prominence to your foreground subject, you may find it more effective to get closer rather than to zoom in. However, get too close and your subject may feel self-conscious. Close-up portraits can also make nearer facial features look bigger than more distant ones – in other words, it makes people's noses look big.

**WORK WITH THE LIGHT**

It's useful to be able to react to tricky lighting conditions,

but sometimes you can go further and actively decide what light you want. The hour after sunrise and before sunset are known as the golden hour, as the low sun gives warm colours and long shadows that can really flatter subjects. You might not plan your whole day around it, but this is a great time for dramatic landscapes, romantic portraits and pretty much anything else.

Midday sun can produce harsh shadows that come out as solid black. If you're shooting during the day you may find that a shady spot produces more flattering portraits.

Larger expanses of light give softer shadows with a gradual fall-off from light to dark, and this can work brilliantly for portraits. Professional photographers use lights mounted behind large white sheets called soft boxes, but you can achieve a very similar result by positioning subjects near a window.



Some photos demand a specific aspect ratio. We chose a square for this shot as the pig looked like it was posing for its Facebook profile picture



Triangles often make for a strong composition. We'd like this shot even more if the background was less busy

This produces a soft sheen that can give skin a beautiful translucent quality.



HOLD STEADY

Enthusiasts' cameras have chunky handgrips and are relatively heavy, both of

which make them easier to hold steady. They also have optical stabilisation to counteract any shakes that do occur. Smartphones rarely have any of these traits and so holding them steady can be quite a challenge.

If your smartphone has a physical shutter button, you'll probably find that this makes it easier to keep steady than using an on-screen button. Squeeze the phone or camera at the top and bottom rather than press the shutter button, as this avoids movement as you take the shot.

Daylight shots are usually captured at fast shutter speeds so blur isn't a problem, but low-light shooting can be more of a challenge. Cameras can compensate by raising their ISO speed, which makes them more sensitive to light but also increases noise. As a result, many cameras don't raise their ISO speed enough to avoid blur in low light. If you find this to be a common problem, try leaning against a wall, table or chair to help keep the camera steady.



CREATE SHAPES

Some photographers put a huge amount of effort into

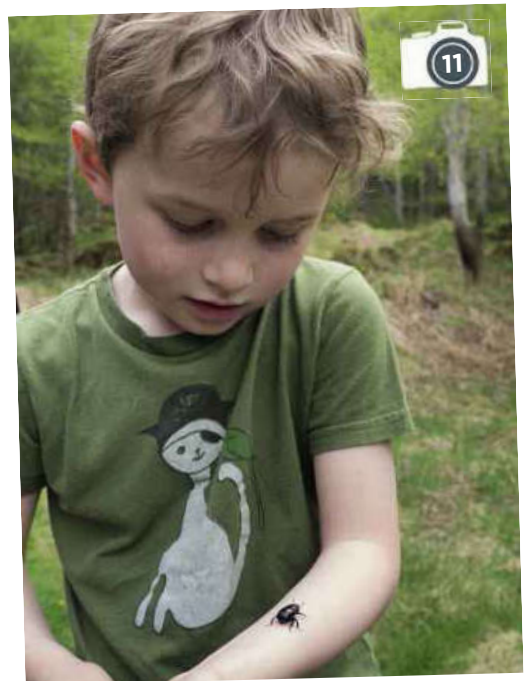
creating strong compositional shapes in their photos – lines that lead the eye through the frame from the main subject through to other points of interest. Converging lines are particularly striking, and triangles often make for a strong composition. Photographers often look for shapes that complement each other, with a symmetry or similarity between different elements in a photo.

If that seems like too much effort, there are simpler compositional techniques you might want to try. The rule of thirds involves dividing the frame into a 3x3 grid and placing key elements on the lines and intersections. This tends to be more interesting than placing subjects dead centre. If a subject is facing to the left or right, position them to one side looking towards the centre of the frame.



GO UNDERCOVER

Not everyone enjoys having their photo taken. Sadly it's a vicious circle: point a camera at them and they become tense and start protesting that they always look awful in photos. Then of course it turns out to be



People don't need to be smiling down the lens. Some portraits work better when the subject is interacting with someone or something else. Getting in close with wide-angle zoom gives a sense of intimacy that would be lost if we'd stepped back and zoomed in

true, as people tend not to look their best when they're tense or annoyed.

The only solution is to be a bit sneaky and try to catch them unawares. A big zoom can help with this, and so too can a tilting screen that lets you keep the camera down at hip level. Natural rather than posed shots will often be more interesting regardless of how people feel in front of the camera. Not everyone can smile on demand – especially children – so it's often better to capture them interacting with each other rather than standing around staring down the lens.



CLEAN UP

An interesting background can bring a photo to life, but the opportunity isn't always

available. Plastic toys can spoil a photo when they're in the background of a children's portrait. The same applies to washing up, junk mail and all the other things that tend to accumulate around our homes. It's easy to turn a blind eye to them in real life, and you may not notice them when taking a photo as you're concentrating on the main subject. However, they become more visible when viewing photos later. As such, it's worth spending a few seconds clearing surfaces behind your subject, or just changing the angle to avoid distractions.

The same applies when you're out and about. Try to avoid things such as signposts, bins, litter and anything else that distracts from the main subject. You could digitally airbrush them out later, but it will save time if you can avoid them in the first place.

**THINK AHEAD**

If you're photographing people and don't want posed shots, try to anticipate what they might do or where they'll go next and be ready to take a snap. If you're out on a walk, go a few steps ahead so you can capture your companions walking towards you. When a child's birthday cake is about to arrive at the table, find a good spot beforehand so you'll have a clear sight of the birthday boy or girl and the cake that will be placed in front of them.

**ENGAGE THE SUBJECT**

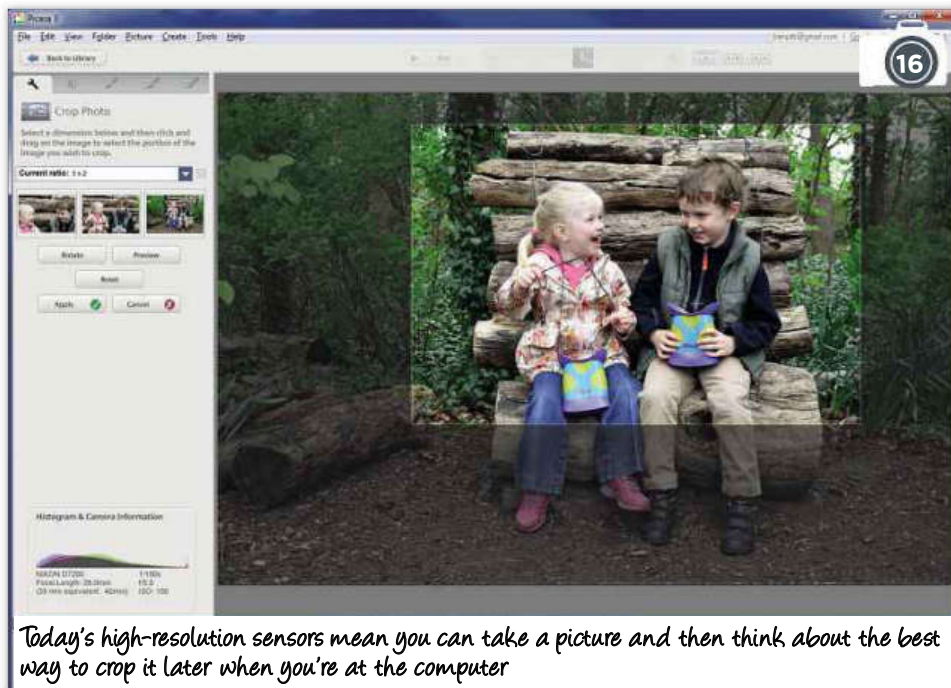
Sometimes you need to interact with your subjects to create an interesting photo. This is particularly true for children. If you want a photo of two or more kids together you'll probably need to stage-manage them to get them all in the frame and facing in the right direction. Pack them in nice and close so there's minimal dead space between them. Your next challenge is to keep them there and hold their interest.

For babies and young children, simply asking someone to make a toy appear and disappear from behind your head as you take pictures can work well. Blow a few raspberries and do some animal impressions and you'll probably have them in stitches. For older kids, try starting a conversation about something they're interested in. You might ask them what they'd like for dinner and then start listing outrageously extravagant dishes. This will get an animated response from people of any age.

Portraits don't have to be all smiles and laughs, though. Get people talking about something they have an emotional connection with or introduce a prop and you'll hopefully capture a portrait that's full of character.

**CAPTURE EVERYDAY LIFE**

All too often we only take photos of special events and unusual sights. However, look back at old photos and it's often the everyday things that are more interesting. The way your garden looked back then, homes you've long since moved away from and what you, your family



Today's high-resolution sensors mean you can take a picture and then think about the best way to crop it later when you're at the computer

and friends looked like back then. While we hate to admit it, people who take lots of selfies might be on to something. Even better, take care to capture well-lit and composed photos of your nearest and dearest in their natural environments. They may be the photos you come to cherish in years to come.

**SHOOT FIRST, CROP LATER**

Ultimately, there's no need to agonise over the perfect composition for your shot. Digital cameras have resolutions from 8 to 28 megapixels, whereas the average Facebook, Twitter or Instagram photo is viewed at around one megapixel. There's no shortage of spare pixels so you can crop photos liberally and still maintain high quality. When shooting, make sure you've got your subjects in the frame with a decent amount of space on all sides. If it turns out to be a shot worth sharing, you can then experiment with different crops and aspect ratios to find a strong composition.

The only proviso is when shooting in low light, where cropping and enlarging shots will increase the visibility of noise. In these circumstances it's worth getting it right in the camera to maximise image quality.

**TELL A STORY**

Photos are often presented in albums with a common theme, such as a holiday or family gathering. When you're taking photos, look out for opportunities to tell the story of the event. For example, for a family barbecue, you might start with a wide-angle photo of the garden. There could be a shot of food going on to the barbecue, another of people standing around discussing how to keep it alight, a couple of shots of children playing, some close-ups of people chatting and finishing off with some goodbye hugs. Thinking about how your photo album will hang together can help you to get shots that you wouldn't otherwise think to take.

**BE SELECTIVE**

When you come to select which photos to share, look for variety and think about the story you want to tell. Imagine recounting an event or holiday in words, and put together a slideshow that depicts the narration. If there are two or three great shots of the same subject, just choose the very best one. Try to avoid missing key people out of the collection. Even if they hate having their photo taken, they probably also hate being excluded from photos. There's no need to use photos in chronological order if they flow better in a different order – particularly when it comes to choosing the first and last in an album.

Finally – and this is the most important bit of advice – be hyper-critical and only use the best photos. We find one in 10 photos are worth sharing, so if you've taken 50 photos, aim to choose the best five. There's nothing wrong with leaving people wanting more. **CS**



Don't forget to capture photos of your normal routine, as you'll really appreciate them in years to come. This shot is helped by a strong symmetrical composition and some warm evening sunlight coming through the window

NEXT MONTH**PRINTING BUREAUX**

When you need multiple prints it's often cheaper and easier to use a professional printer. We explain what's involved

Creative apps for children

Kids glued to the tablet or phone? **Ben Pitt** reveals the apps that can engage their sense of creativity when they're in front of the screen



TRYING TO PRISE your smartphone or tablet out of the kids' grasp can be more trouble than it's worth. There's a lot more to the App Store than Candy Crush Saga, though: there's a huge range of apps that allow children to unleash their creativity. Some grown-ups claim not to be creative, but you'd never hear a child saying that. Kids know instinctively that making pictures, music and stories is fun.

For this article we trawled the Apple App Store and Android Play Store to find the best creative apps for children. We've concentrated on apps for younger children, as anyone aged eight and above should get on fine with the likes of GarageBand, Brushes and Minecraft.

We rejected lots, in some cases because they presented children with a limited set of choices and pre-designed outcomes. For us, creativity should be a freedom to express yourself, so there needs to be an open-ended element to the creative process. We've omitted apps that teach you to play a musical instrument, as this topic was covered in *App Creative*, *Shopper* 325. Other apps were rejected because they were overlaid with adverts or in-app purchases. Some were simply a bit rubbish, or the noises they made were just too annoying.

Most of these apps are compatible with both phones and tablets, but they all work better on the larger screen of a tablet. So without further ado, here's our rundown of the best apps to keep your little cherubs busy while you have a well-earned lie-in on a Sunday morning.

Bloom Tunes

£1.49



www.kaputoys.com

Bloom Tunes is touted as being suitable for 0- to five-year-olds. We'd limit that to 0-3, but catering for such a young audience is no mean feat. Bloom Tunes is a painting app that starts with a petal to colour in using the eight colours provided. Once you've finished, you hold down the watering-can button to water the petal and watch it grow into a flower, complete with your painted petals. Each brush stroke is accompanied by a



musical note, and the flowers make more noises when they're tapped or spun.

Bloom Tunes reminds us of a baby's activity mat, with a simple design, smiley faces and lots of colour and sound. It sounds less annoying than most apps that use a limited set of pre-recorded sounds. We also really like how there's a clear objective and reward, as this encourages children to think critically and finish a design rather than just scrawling away until they get bored. This also makes it much easier to get children to take it in turns with the app – something our team of testers struggled with for most of the other apps.

Bloom Tunes



Decorate musical petals with Bloom Tunes

Art of Glow

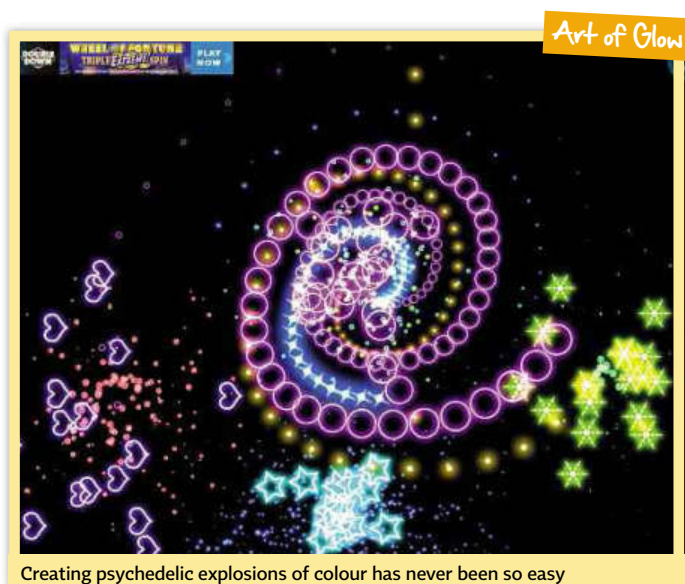
Free



www.natenai.com

Despite its simplicity, Art of Glow is capable of sophisticated results. It's a painting app, but rather than create static brush strokes, each finger swipe creates a line of coloured shapes that blink rhythmically. It's fun to draw recognisable pictures but Art of Glow is at its best when creating abstract patterns.

There are various controls to adjust: the shape, colour and size of the brush strokes, how long they take to fade and regenerate and whether they stay put or drift around the screen. Anyone aged one and up will like being able to doodle away on the screen but younger kids will need help with the settings, if only to reset the canvas when it gets a bit too busy. However, children aged from four or five should be able to get to grips with the controls. It can become quite a complex technical exercise to take full command of them and make animations behave exactly as you want. However, this means it takes longer



to grow out of the app. Based on our experience, it will probably prove quite popular with parents and grandparents too.

The app is free for iOS and Android, but iOS users need to pay 79p for Art of Glow – Pro in order to remove adverts. This version also allows animated drawings to be saved.

Sago Mini Doodlecast

£2.29



www.sagosago.com

There are masses of drawing apps aimed at kids, but Doodlecast stands out because it includes just enough prompting to help children really engage with it. There are 38 templates, each with a simple drawing and a spoken question to help get kids started: "What's your favourite food?", "Who's having a party?", "What's happening in the sky?".

Drawings are created using a palette of nine colours and three brush sizes. The app not only captures the drawing but also an animation of the brush strokes. It records from the microphone too, capturing the conversations that occur while children draw. The app's creators describe how young children's drawings are as much about the process as the finished result, and Doodlecast records both. These narrated animations are played back after the picture is complete, and can be exported as a video file.

Loopimal

£24.9



www.yatatoy.com

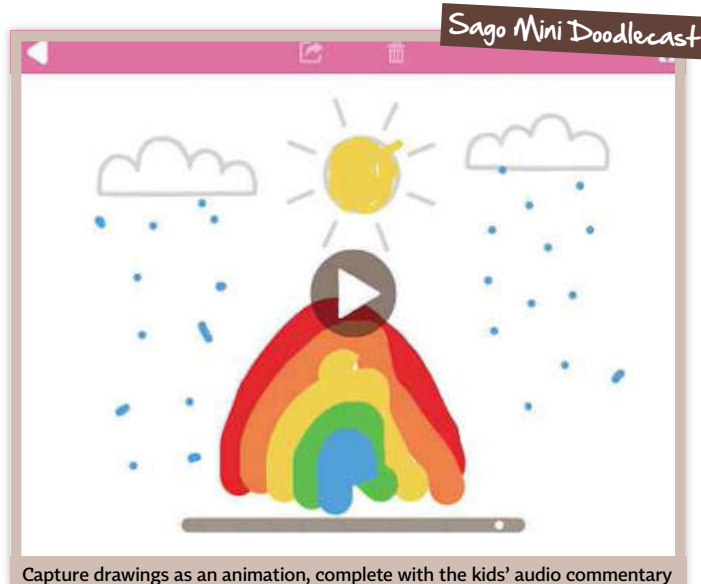
Loopimal is perhaps the least expressively creative app in this round-up, but it's simply

too delightful to ignore. Children sequence and layer pre-recorded musical loops, and each loop is accompanied by an animated dancing cartoon animal. There's a yeti, sloth, pig, bird, bear and octopus. Each one comes with five short loops that are arranged in an eight-bar pattern.

The music is as beautifully crafted as the animations. There are no generic dance music loops or guitar riffs; instead, animals produce a variety of musical sound effects that tie closely with the animations. The yeti makes primal percussive noises, the sloth sounds like a new-age musical box, and the pig combines xylophone with bumps and hand claps.

Each animal has its own simple backing track to play along to, but tapping the + icon reveals options to combine two or four animals to have a jam together. All the music is in C major so it's easy to play along with real instruments, too.

We'd love it even more if it was possible for two children to perform with two animals



at the same time – the controls are for one animal at a time. It would be amazing if the animals could leave their respective corners and interact with each other, although admittedly that would be a far more complex app to program. Regardless, Loopimal is a joy to use for kids and grown-ups of all ages.

Toca Band

Free



tocaboca.com

This is another loop-based musical app, and with only one song available Toca Band has the potential to drive parents completely crazy. The truth is, though, we love it, and found ourselves singing the song long after the kids had gone to bed.

There are 16 animated characters, each with their own instrument. They include an opera singer, a tap-dancing spider, a drum kit dressed as a chef and a cat with a mouthful of space bubbles. There are eight podiums on the stage, and each character plays a variation of their musical part depending on the colour of their podium. The green loops are sparser, blue are more intense and red



are somewhere in the middle. The star podium lifts the character up to its own screen where you can perform a solo. This is much closer to performing with an instrument rather than just choosing loops, and the bizarre animated controls really add to the sense of fun and adventure.

The other apps from Toca Boca have a similar zany flair, and many are available for Android and well as iOS devices. Toca Mini (£249) is particularly charming, letting kids design animated characters from a selection of colours, features, clothes and accessories. Toca Band comes top for creativity, though, which is why it makes our list.

Bubl Draw

£249



bublbubl.com

Bubl Draw is remarkable in that it's equally a drawing app and a musical app. There's a palette of six colours, each corresponding to a different instrument. These colours and instruments change depending on which of the four musical styles is selected, with a choice of Classic, Disco, Latin and Jazz.

The music behaves differently depending on whether you draw a dot, a line or a joined up line to create a shape. Tapping an existing dot plays a note, with the pitch varying depending on where it is on the screen. Tapping a shape plays a short musical phrase, while tapping a line creates a dot that rattles around inside the line, playing notes as it goes. In fact, these seemingly random notes are locked to a common tempo, so layering them up produces coherent musical textures. Dots, lines and shapes can be rearranged, resized and discarded off the edge of the screen. There's also a bank of simple ready-made drawings to play with.

We love how Bubl Draw merges the concepts of drawing and music making. Children themselves don't have predefined expectations, and this plays to their innate sense of creative experimentation.

Bubl Draw

Bubl Draw is a delightful mix of musical and artistic creation

Meanwhile, older children – and grown-ups – can think of it as an instrument that you design and customise as you perform. Both the drawings and music are enjoyably abstract and quirky, and there's plenty of variety to hold the interest.

ScratchJr

Free



(tablets only)



(iPad only)

www.scratchjr.org

ScratchJr is an introduction to computer coding for five-to-seven-year-olds. That might sound like an ambitious objective – and we suspect it probably is – but with a bit of help they should be able to get to grips with it.

At its simplest, ScratchJr is a drawing app with a library of cartoon animals, people, cars, buildings, trees and backgrounds to choose from, colour in and customise. It's also possible to draw from scratch and to incorporate photos from the device's camera – perfect for adding your own face to a cartoon character.

The fun really starts when you sequence commands together for each element. These can be programmed to move, grow, shrink and speak, either via a speech bubble or a sound recording. These events can be triggered at the start of the animation, when the element is tapped or when it bumps into or receives a command from another element. It's also possible to loop sequences and progress to another page.

It took us a little while to figure out the potential of ScratchJr. It isn't really up to the demands of game design but excels for interactive storybooks. Projects can be shared by email, although recipients will need the app to be able to play them. We found the interface and performance to be a little clunky at times, but ScratchJr gets full marks for ambition and creative potential.

ScratchJr



Get to grips with the basic concepts of coding with this animated story editor

Friendstrip Kids Pro

Free, includes in-app purchases (iOS), 99p (Android)



www.friendstrip.com

This app is aimed at children aged six to 12, but younger kids can get involved too with a bit of help. It lets them bring comic strips to life by superimposing themselves into the action via the device's camera. Each strip is just three or four cells long, but that's enough to keep kids busy for a few minutes and not so long that they grow impatient.

Most strips are designed for a cast of two, and in some cases you'll need a third person to take photos. Alternatively, children could use their toys as actors. If they want to take it more seriously, they could dress up and add extra props. Speech bubbles can be rewritten, and it can be great fun repurposing the comic strips for completely different storylines.

The app is free for iOS devices, and includes one comic strip for each of the 16 categories. Additional strips are available as in-app purchases for 79p a set, but you may as well buy the whole lot for £149. The Android app costs 99p and includes all the content as standard. **CS**



The kids are the stars of the strip

NEXT MONTH

QUARK DESIGNPAD

Is an iPad up to the demands of DTP?
We take Quark's free app for a test drive

Zygote

Despite appearances to the contrary, **Zygote** has never touched any performance-enhancing drugs. It seems the same can't be said for video gamers

GAME OVER

The Electronic Sports League is the biggest organisation in the world for video games players. Based in Germany, it boasts over a million teams with five million registered members. The leagues are international, and players compete for prize money during exhibitions, conventions and games shows, many of which are televised on cable TV channels.

Alas, there are suspicions that some competitors regularly cheat, not by hacking the games, but by taking performance-enhancing drugs, so the League has announced the introduction of doping tests. But seeing as the habitual state of most video gamers is one of slack-jawed, snot-nosed, bug-eyed, twitching, Zygote wonders what difference the drugs can make, or how anyone can possibly tell.

FRENCH LEAVE

Microsoft recently stopped support for Windows Server 2003. When the clock ticked past the deadline, several alarming facts emerged about the UK's emergency services and the NHS. One in five of these bodies is still running the old software, so is at the mercy of any new viruses and hack attacks. In London, it's even worse. Half of the Metropolitan Police's computers use the outdated platform, and the figure is even more grim for the London Ambulance Service.

Many organisations will be vulnerable for months; Norfolk Fire and Rescue admits it won't be able to update until late in 2016. As for Greater Manchester Fire and Rescue, with a quarter of its servers running Windows 2003, they are on record as having no plans to migrate at all.

They're not mad. They're not incompetent. The plain fact is they are strapped for cash because of the huge cuts imposed by the government. With Microsoft charging silly money for licences, they simply cannot afford to upgrade.

French government advisers, meanwhile, have recommended that our Gallic neighbours scrap their reliance on Microsoft for all state computers in favour of open-source software. This will save a fortune, and it's a gigantic missed opportunity not to follow suit this side of the Channel.

FLIGHT OF FANCY

United Airlines is so worried about software bugs that it awards huge numbers of air miles to bug-hunters who can spot flaws in its computer systems. And the hackers are cashing in. It took Florida-born Jordan Wiens just three hours to break into the UA system and find his first bug. By the following night he'd landed a second one. Instead of prosecution, United awarded him 1,250,000 air miles. That's enough to fly him round the world 50 times.

Another enterprising hacker, Nathaniel Wakelam from Melbourne, bagged half a million air miles following a 'high impact' hack that took him 10 hours to execute, and he has identified a dozen similar flaws since.

What interests Zygote is the fact that the United Airlines fleet has been grounded by software glitches since the bug-bounty was announced, meaning that there are hackers out there who really don't want to claim their air

miles. Perhaps they have a fear of flying. Speaking of which...

DRONING ON

The aviation authorities are worried that computer-controlled drones pose a threat to aircraft. Not the military drones that cost millions, but the little plastic jobbies that cost a few quid. UK law says personal mini aircraft are not to be flown within 150 metres of a 'congested area', or an open-air assembly of more than 1,000 people, or within 50 metres of any vessel or vehicle or structure not under the control of the drone operator.

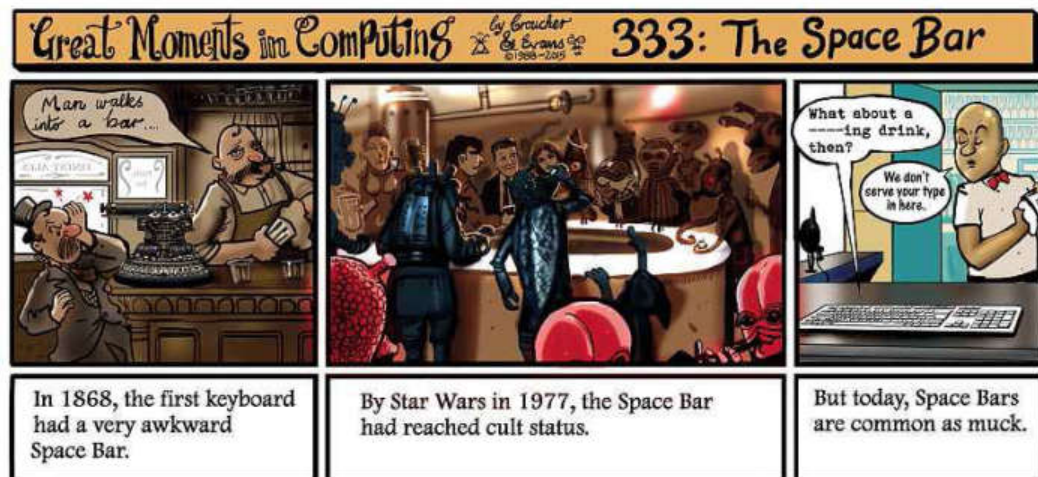
We're also restricted from taking photos of people within these limits, under the Data Protection Act, and we're not allowed to lose sight of our drones while operating them.

It's virtually impossible to monitor, police or enforce these diktats, and they're flouted every hour of the day. Not so in New Zealand, where personal aircraft have been banned, unless the operator gets written permission from the owners or occupiers of all property and land to be flown over. This includes teeny-weeny drones that are featherlight and can land on the palm of your hand, as well as old-fashioned model aircraft. In other words, the new technology has, in effect, killed a traditional hobby.

DO-OUGH!

According to the company's latest accounts, the discerning British public orders £850 million worth of Domino's Pizza online every year. This generates £60 million in profits. In which case there's no doubt Domino's could afford to buy the newly endowed domain name dominos.pizza for the measly asking price of 45 quid. Neither is there any doubt that its brand executives are paid enough to make sure that the Domino's online empire is protected.

But despite having exclusive access to bag the domain under the 'sunrise registration system' for major brand owners, Domino's simply didn't bother to buy it. Eventually dominos.pizza was bought by Mr CJ Sculti, who lives in Rye. It seems reasonable to assume that if Mr Sculti had set up a pizza-delivery website he could have attracted oodles of orders. Alternatively he could have caused any amount of damage to Domino's reputation, such as it is. But he did neither of these things, and simply sat on the domain name. Now Domino's Pizza has decided it desperately needs to own the domain after all, and must stump up to the National Arbitration Forum to try to claim it. Zygote sincerely hopes their crust gets well and truly double-stuffed. ☑



TP-LINK®

ONE ROUTER FOR ALL CONNECTIONS



**CABLE
PHONE
3G/4G
FTTH**

ARCHER VR900, AC1900 DUAL BAND GIGABIT
VDSL/ADSL MODEM ROUTER, DESIGNED TO WORK WITH
CABLE, PHONE, 3G/4G & FTTH CONNECTIONS



twitter.com/TPLINKgaming

amazon.com

facebook.com/TPLINKUK





DS115j AND DS215j

THE PERFECT DATA STORAGE SOLUTION FOR YOUR HOME

Run your own personal cloud from the comfort and security of your home



POWER-SAVING AND RELIABLE

DS215j features a dual-core CPU, supports up to 12TB of data and consumes less than 14w when active while the DS115j offers a stable storage environment for users with no need for raid, consuming less than 11w when active.

ACCESS ANYWHERE, ANYTIME

Synology NAS' and the intuitive DiskStation Manager (DSM) software allow users to sync and share files among multiple devices, including Windows PC, Mac, Linux, iOS, Android and Windows Phone.

MULTIMEDIA CENTRE

Audio Station, Photo Station, Video Station and Media Server transform your Synology NAS into a centralised multimedia hub.

Where to Buy

amazon.co.uk

The electronics specialist
maplin

Synology apps available on

iOS



Synology's Media
Accolades

